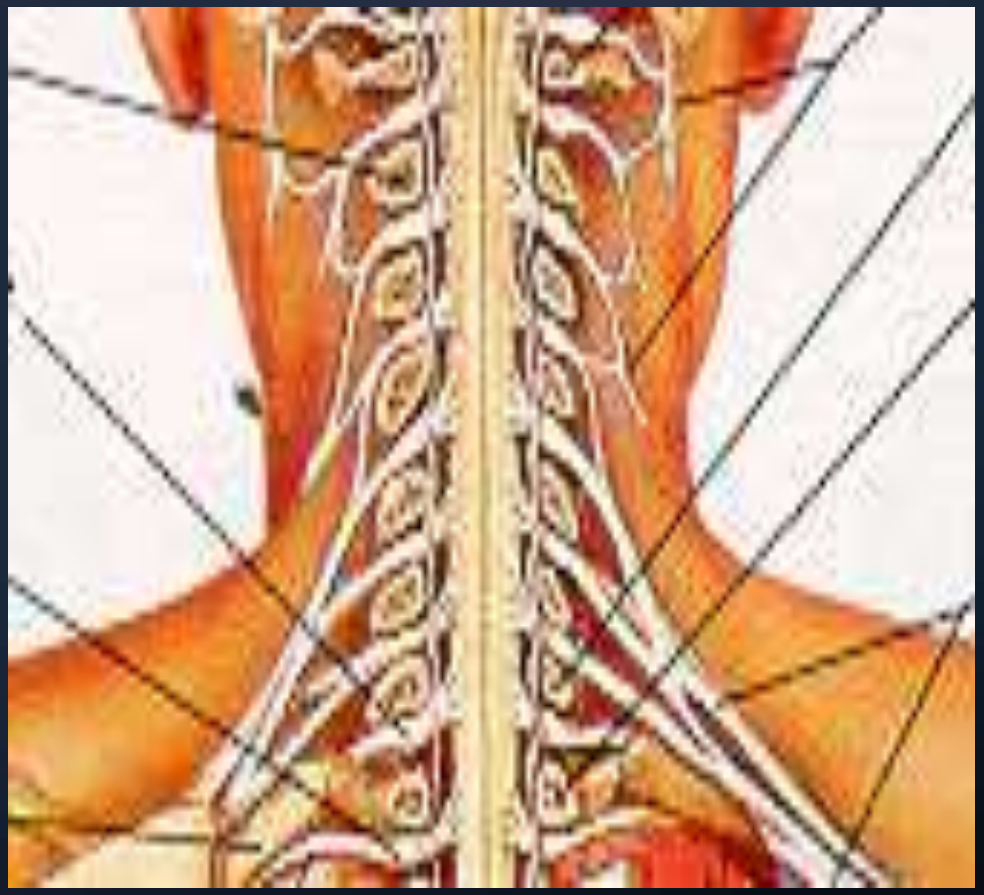
Cervical Radiculopathy and Myelopathy

Wayne Cheng, MD

Bones and Spine

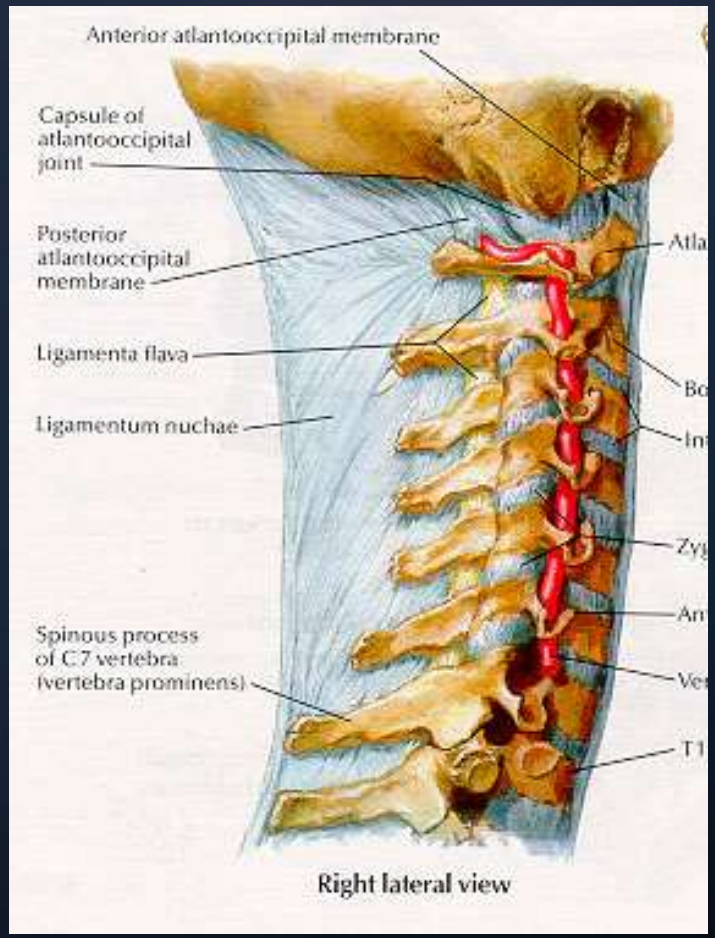
Overview

- Anatomy
- Epidemiology
- Natural History
- Clinical Presentation
- Radiology
- Treatment
  - Non-Op
  - Operative
- OITE Questions



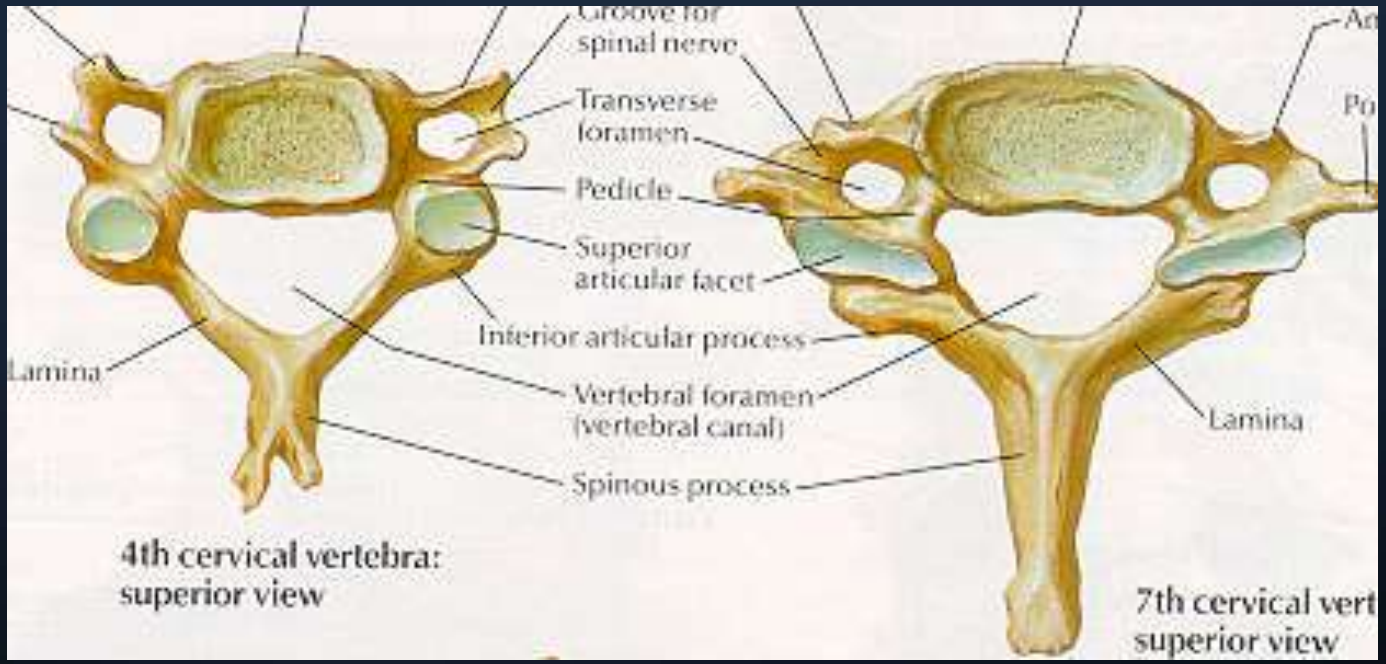
Anatomy

- Occiput
- C1 Atlas
- C2 Axis
- C3-C7

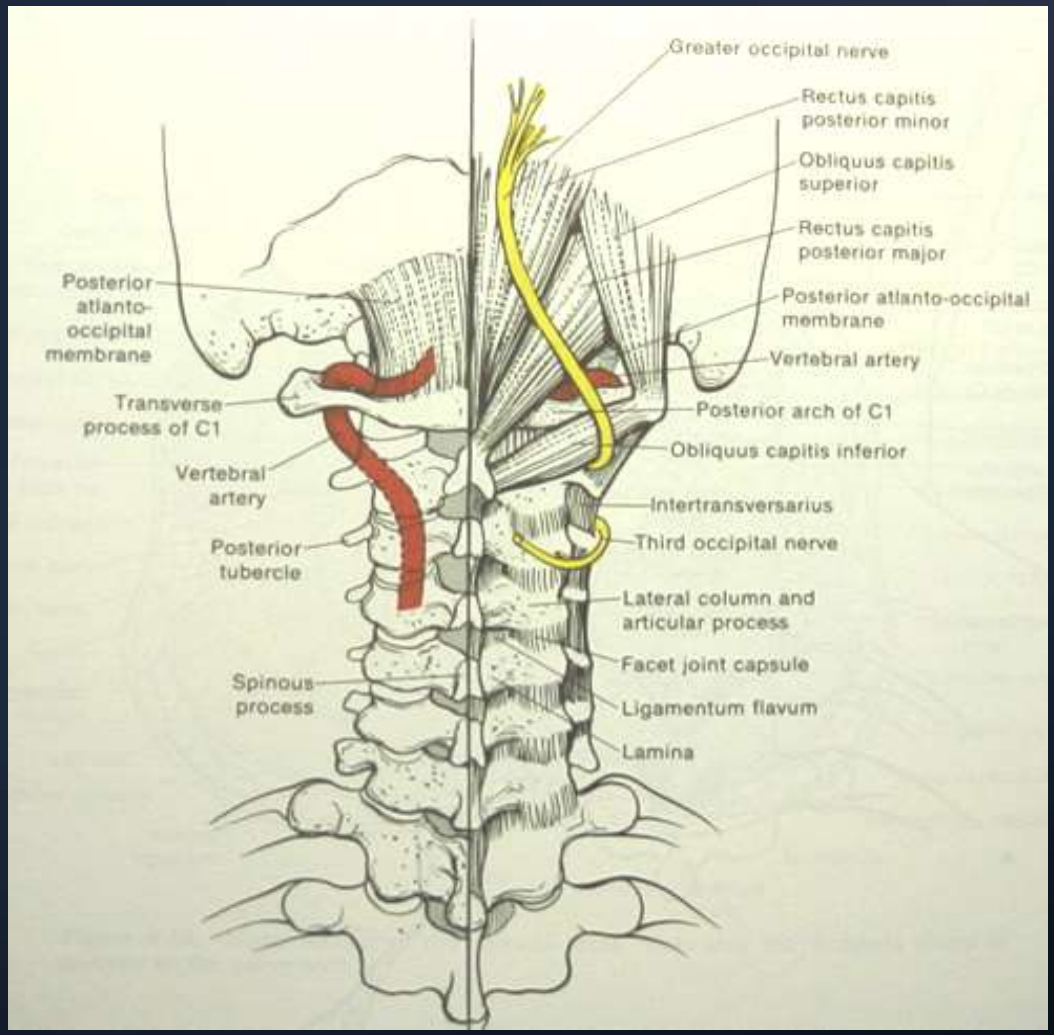


Anatomy

- **Vertebral bodies of C3-C7 are similar**
  - Function and appearance

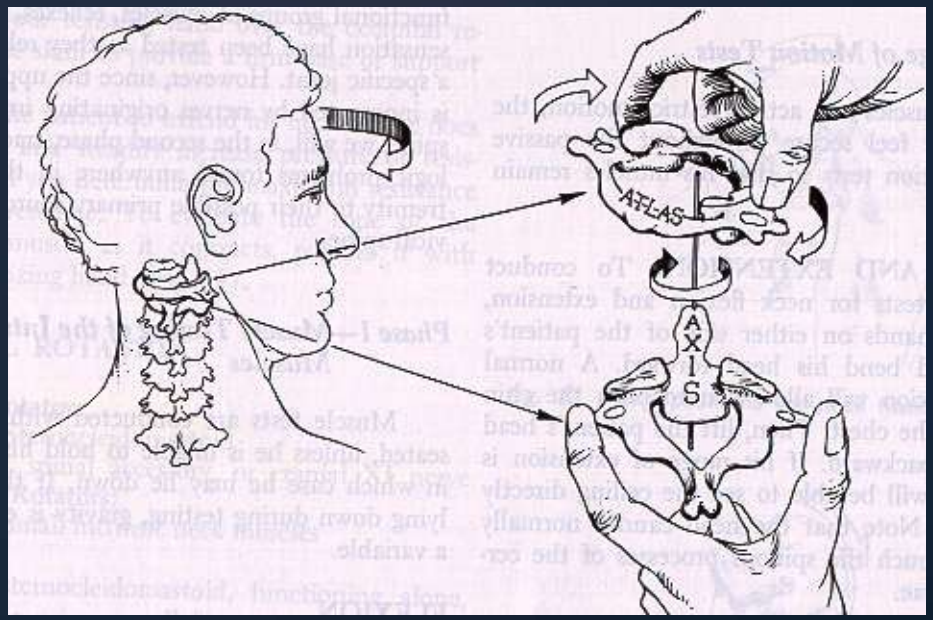


Anatomy

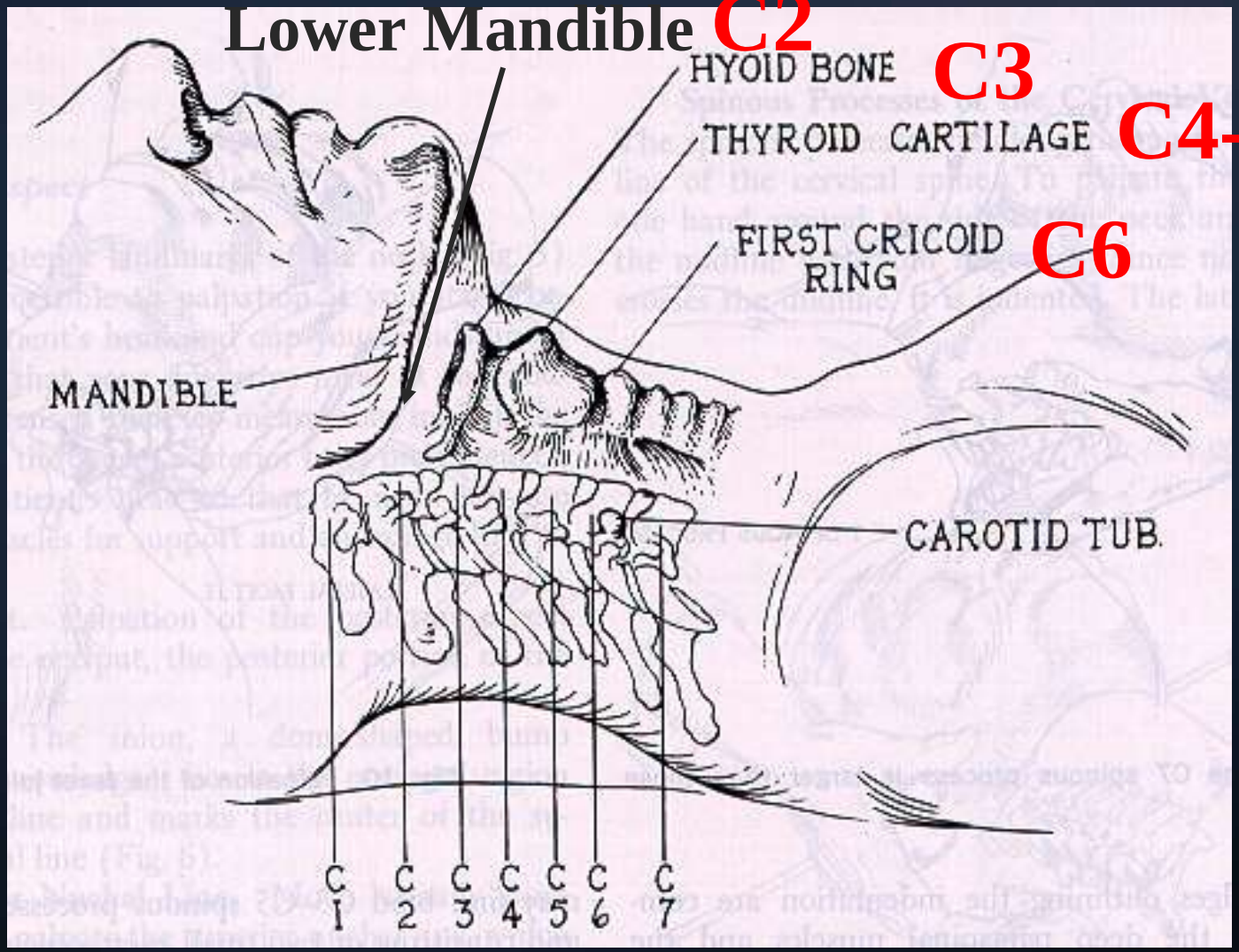

Greater occipital nerve
Rectus capitis posterior minor
Obliquus capitis superior
Rectus capitis posterior major
Posterior atlanto-occipital membrane
Vertebral artery
Posterior arch of C1
Obliquus capitis inferior
Intertransversarius
Third occipital nerve
Lateral column and articular process
Facet joint capsule
Ligamentum flavum
Lamina
Posterior atlanto-occipital membrane
Transverse process of C1
Vertebral artery
Posterior tubercle
Spinous process

Anatomy

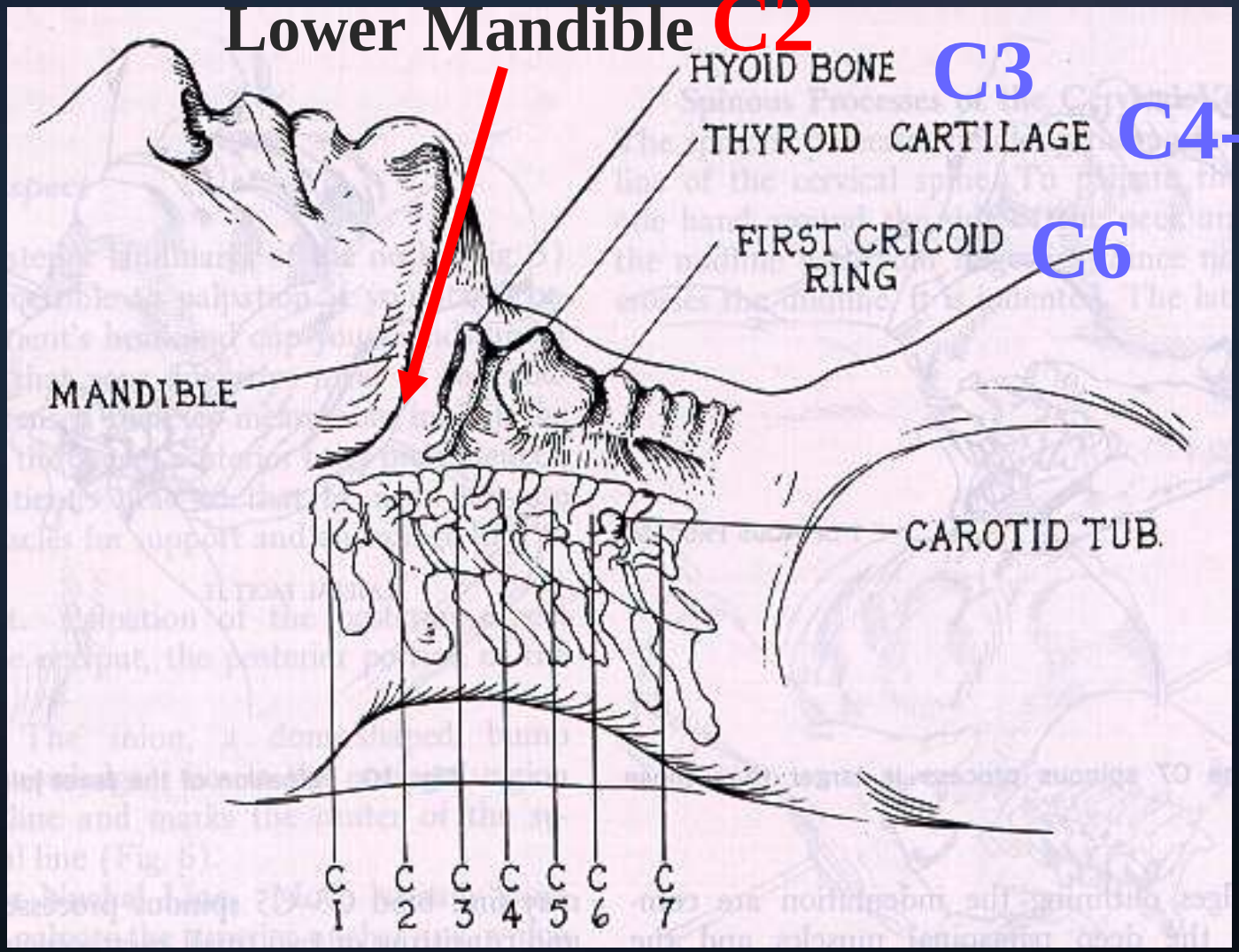
- **Occipital atlantal joint**
  - 50% flexion extension
- **Atlantoaxial joint**
  - 50% cervical rotation



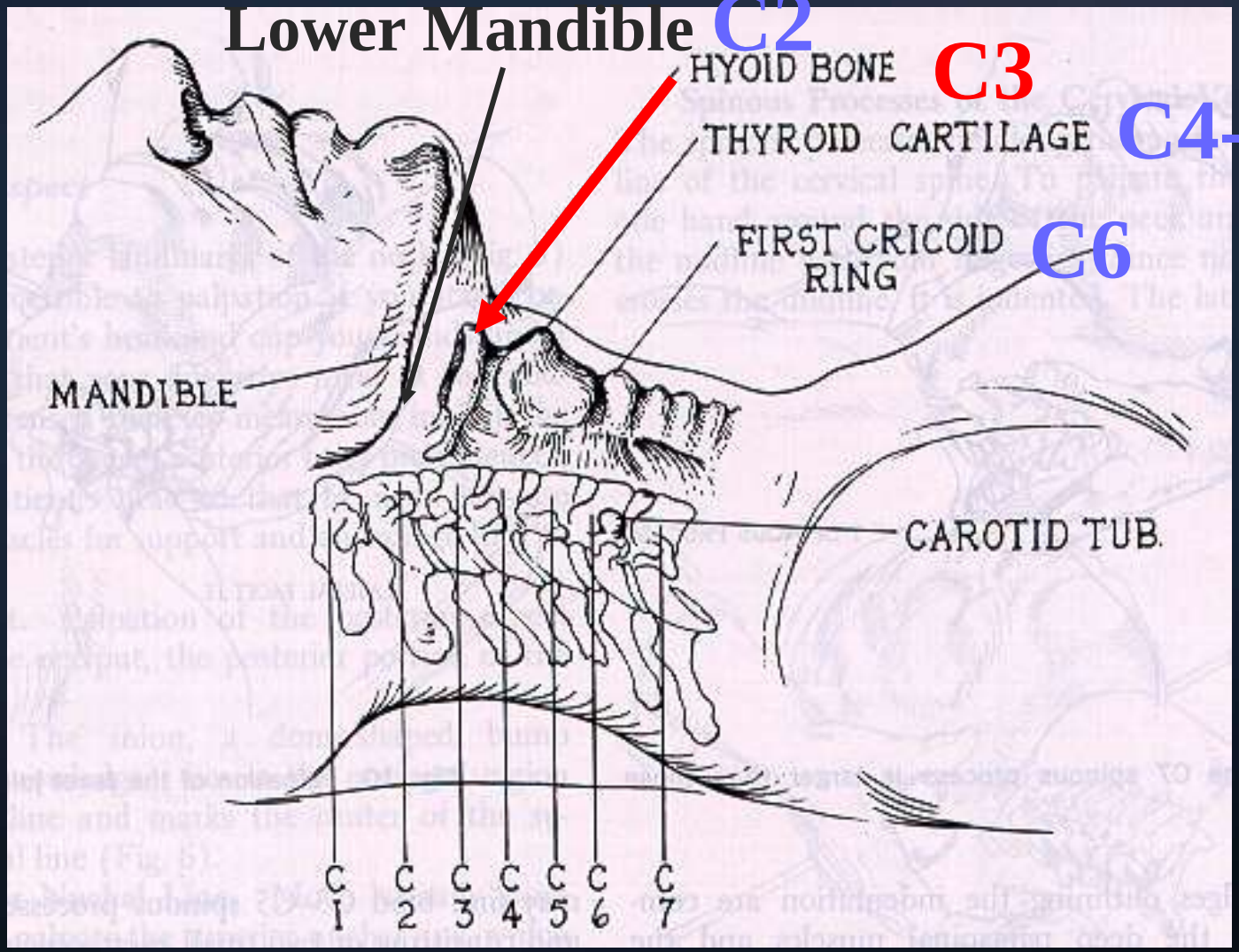
Anatomy


Lower Mandible
C2
HYOID BONE
C3
THYROID CARTILAGE
C4-5
FIRST CRICOID RING
C6
MANDIBLE
CAROTID TUB.
C 1
C 2
C 3
C 4
C 5
C 6
C 7

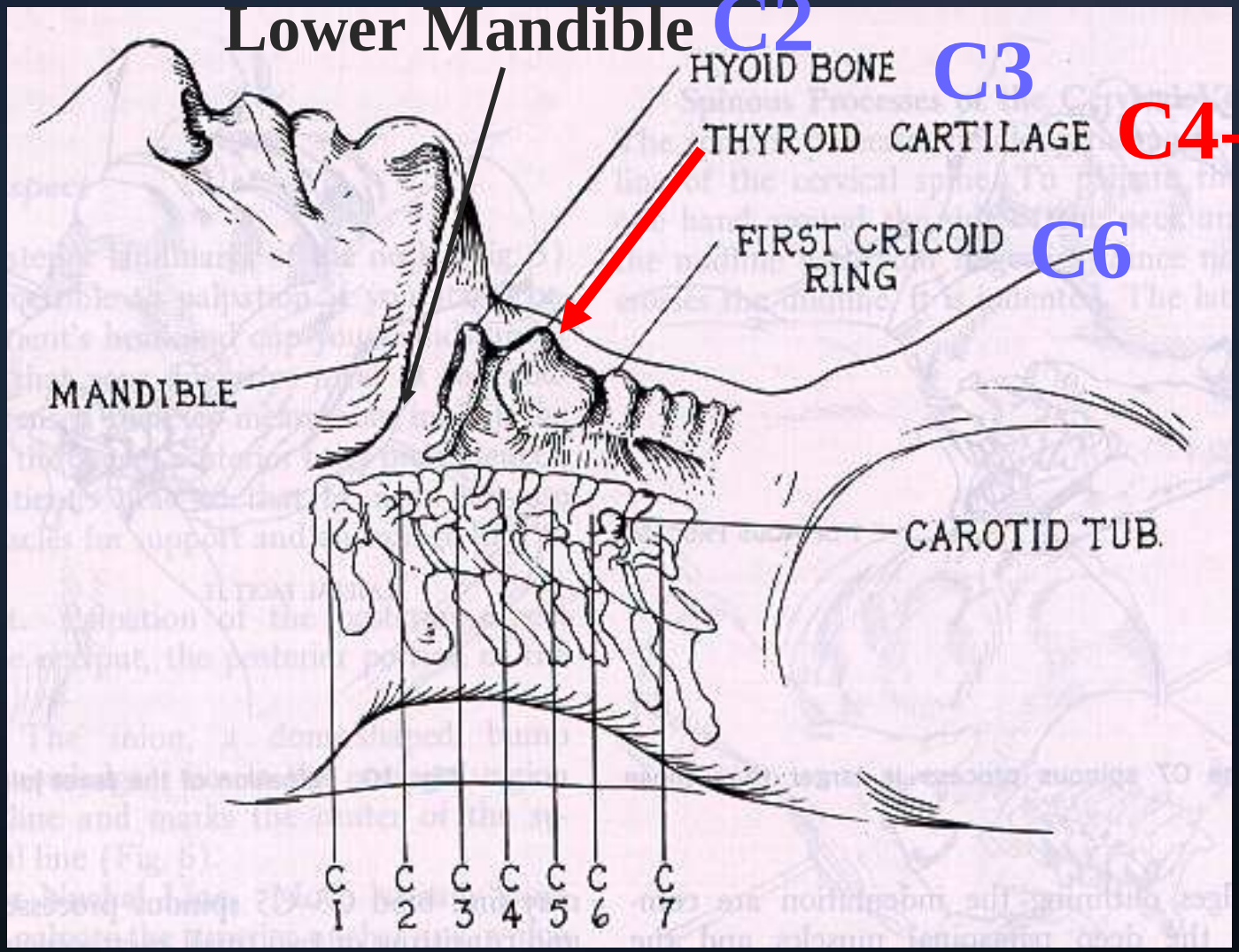
Anatomy


Lower Mandible
C2
HYOID BONE
C3
THYROID CARTILAGE
C4-5
FIRST CRICOID RING
C6
MANDIBLE
CAROTID TUB.
C 1
C 2
C 3
C 4
C 5
C 6
C 7

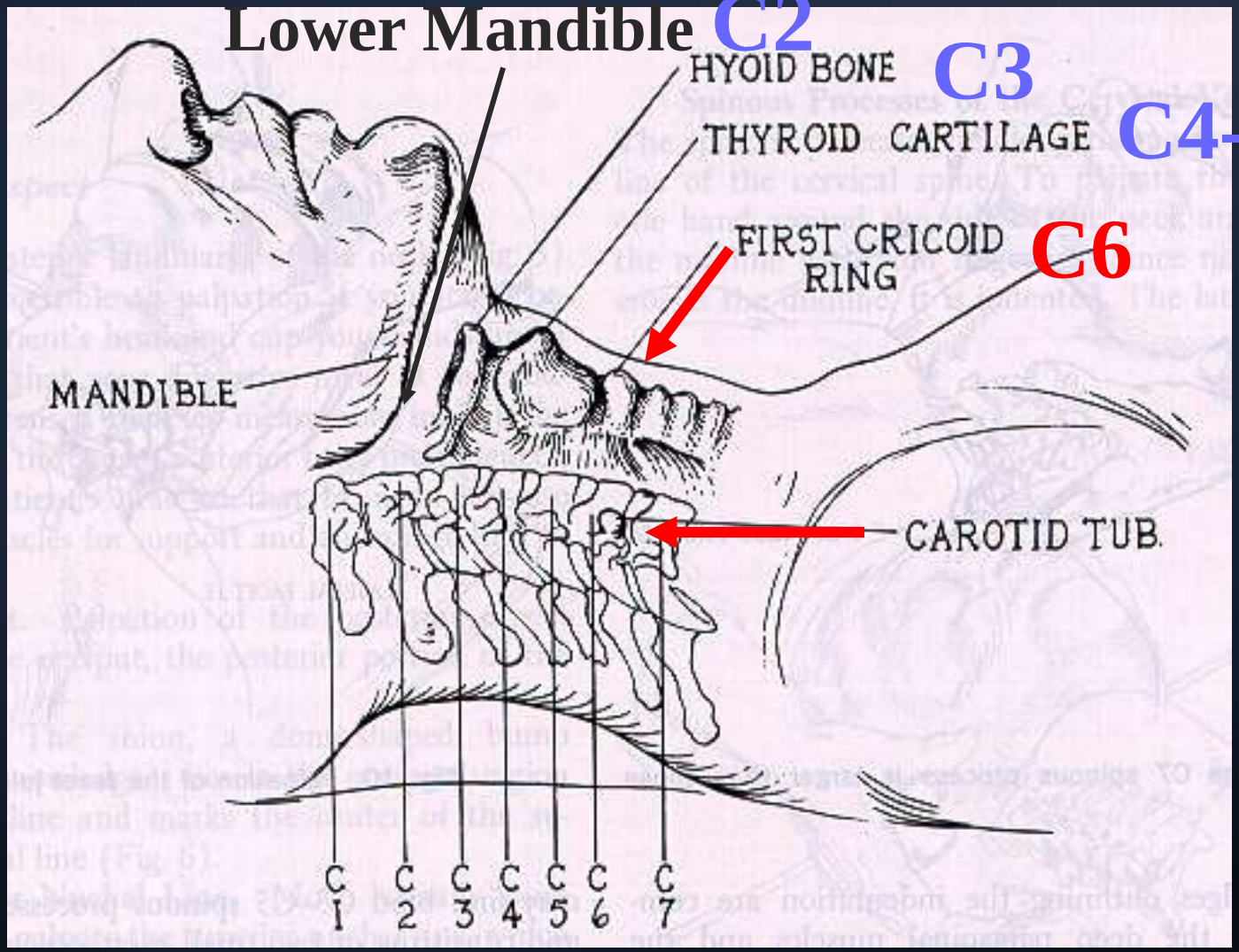
Anatomy


Lower Mandible
C2
HYOID BONE
C3
THYROID CARTILAGE
C4-5
FIRST CRICOID RING
C6
MANDIBLE
CAROTID TUB.
C 1
C 2
C 3
C 4
C 5
C 6
C 7

Anatomy

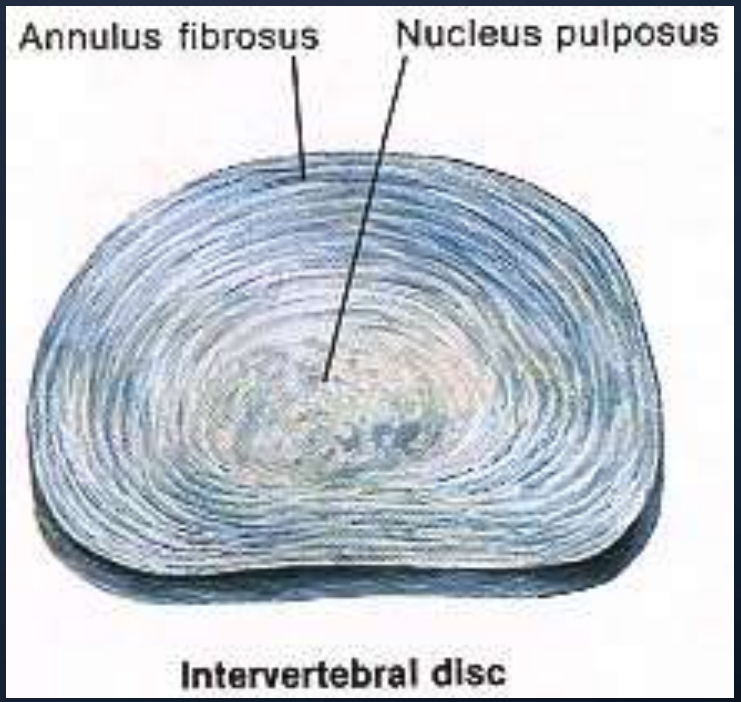

Lower Mandible
C2
HYOID BONE
C3
THYROID CARTILAGE
C4-5
FIRST CRICOID RING
C6
MANDIBLE
CAROTID TUB.
C 1
C 2
C 3
C 4
C 5
C 6
C 7

Anatomy


Lower Mandible
C2
HYOID BONE
C3
THYROID CARTILAGE
C4-5
FIRST CRICOID RING
C6
MANDIBLE
CAROTID TUB.
C 1
C 2
C 3
C 4
C 5
C 6
C 7

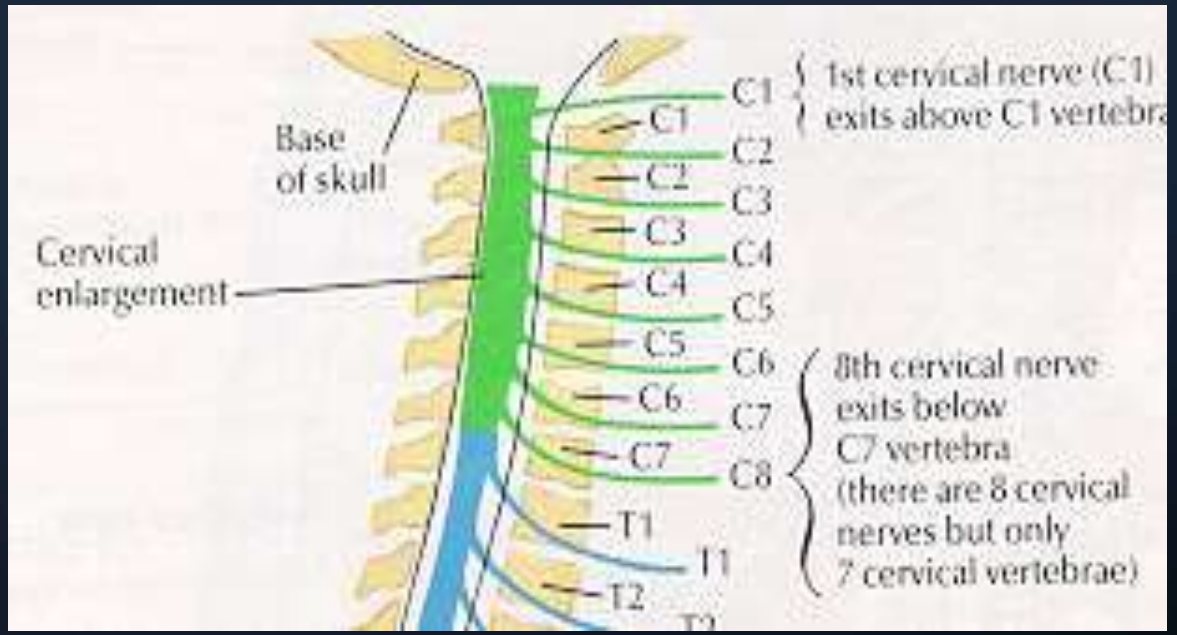
Anatomy

- **Disc between bodies of C2-C7**
  - Outer annulus fibrosus
  - Inner nucleus pulposus
    - Force dissipaters
    - Thicker anteriorly, cervical lordosis



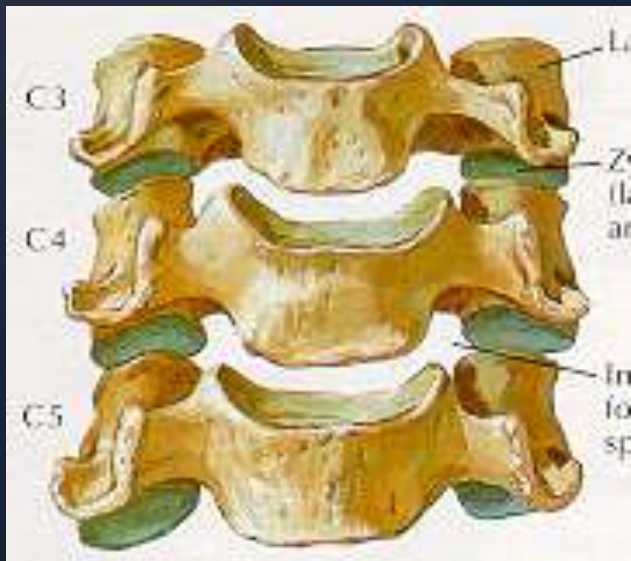
Anatomy

- **Cervical nerve roots exit above corresponding vertebral body C1-C7**
  - C1 exits b/t occiput & C1 body
  - C8 exits below C7



Anatomy
Neuroforamina

- Anteromedially uncovertebral joint
- Posterolaterally facet joint
- Superiorly pedicle of above vertebrae
- Inferiorly pedicle of below vertebrae
- Medially edge vertebral end plates & intervertebral discs

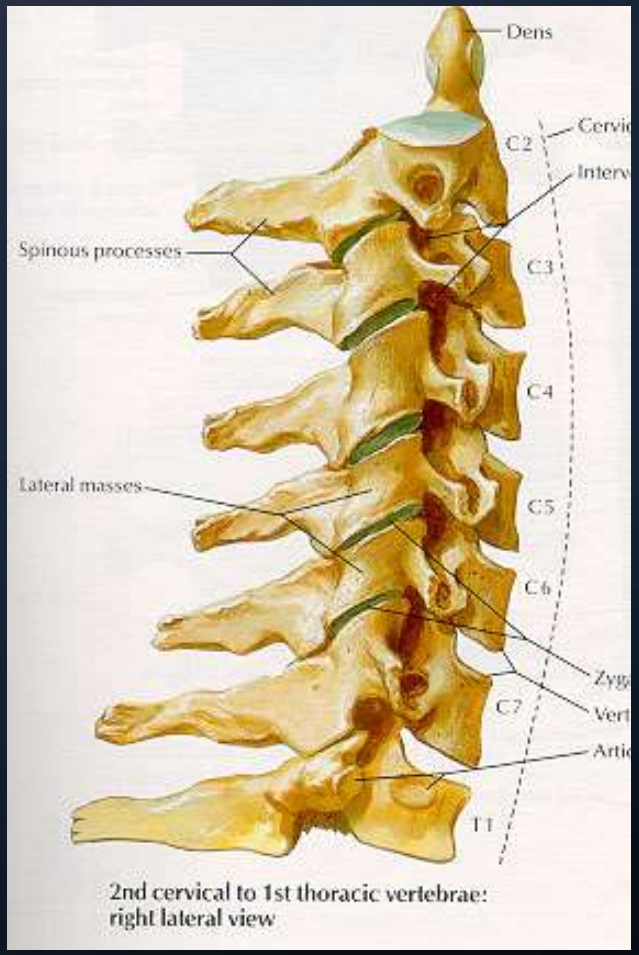


3rd, 4th and 5th cervical vertebrae: anterior view

Anatomy

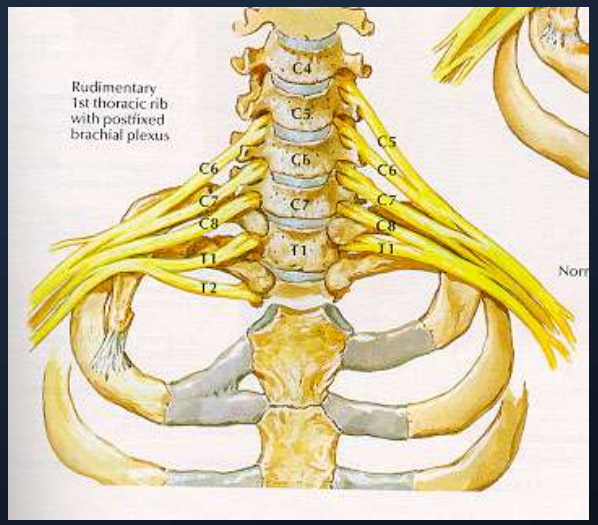
Neuroforamina

- Foramina largest at C2-3
- Progressive decrease in size to the C6-7 level
- Nerve root occupies 25-33% foraminal space



Definition

- **Radiculopathy**
  - Functional disturbance of spinal nerve root
- **Myelopathy**
  - Functional disturbance of the spinal cord



Vs.

Radiculopathy

Incidence

Natural History

Diagnosis

Myelopathy

?

Cervical Radiculopathy

Risk Factors

- **Heavy lifting**
  - > 25lbs repetitively
- **Smoking**
- **Driving/operating vibrating equipment**
- **Previous trauma 15%**

Cervical Radiculopathy

Epidemiology

- **Annual incidence .85/1000**
  - Peak 4th & 5th decades
  - 2.1/1000 incidence
- **Prevalence 3.3/1000**
  - Less frequent than lumbar spine
- **M > F ?**
- **C6 & C7 roots**
  - most commonly affected
- **Degenerative changes > disc herniation**

Cervical Radiculopathy

Epidemiology

- **Younger patients**
  - "Soft" disc herniation
  - Acute injury causing foraminal impingement
- **Older patients**
  - Foraminal narrowing from osteophytes
  - More axial neck & interscapular pain

Natural History

- ***Radiculopathy***
  - 43% no sx after 4 wks
  - 30% mild sx.
  - 27% continue to have significant sx.
    - Lee and Turner 1963 BMJ
- ***Myelopathy***
  - *Epstein:*
    - 36% improve
    - 20% deteriorated
  - *Symon:*
    - 67% relentless progression
  - *Clark & Robinson:*
    - 50% deteriorated.

Differential Diagnosis

Cervical Radiculopathy

- **Tumors**
  - Intracranial
  - Axillary schwannoma
  - Osteochondroma
- **UE mononeuropathies**
  - Radial
  - Median
  - Ulnar
- **Thoracic Outlet Syndrome**

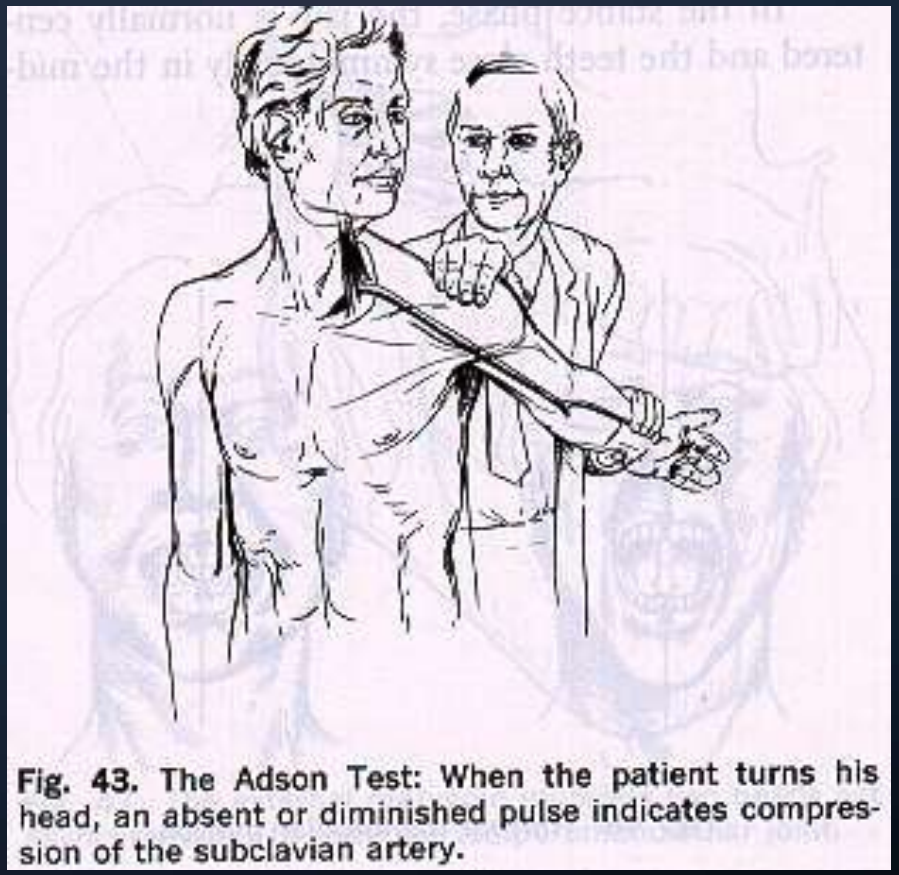
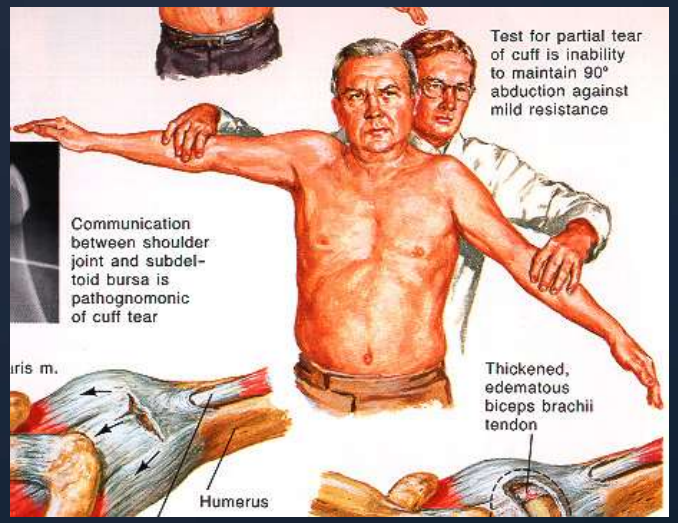


Fig. 43. The Adson Test: When the patient turns his head, an absent or diminished pulse indicates compression of the subclavian artery.

Differential Diagnosis

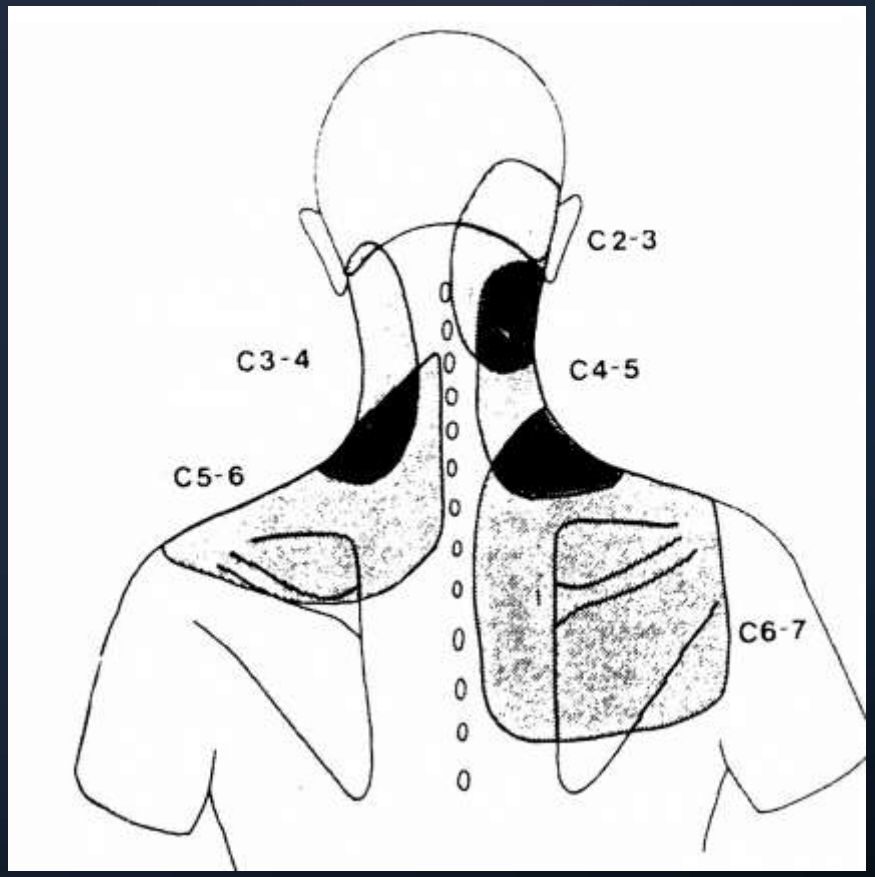
Cervical Radiculopathy

- **Brachial Plexus disorders**
- **Primary shoulder disease**
  - Rotator cuff
  - Adhesive capsulitis
  - Glenoid cyst
- **Epidural varicose veins**
- **Vertebral artery dissection**
- **Infections**



Referred Pain Distribution

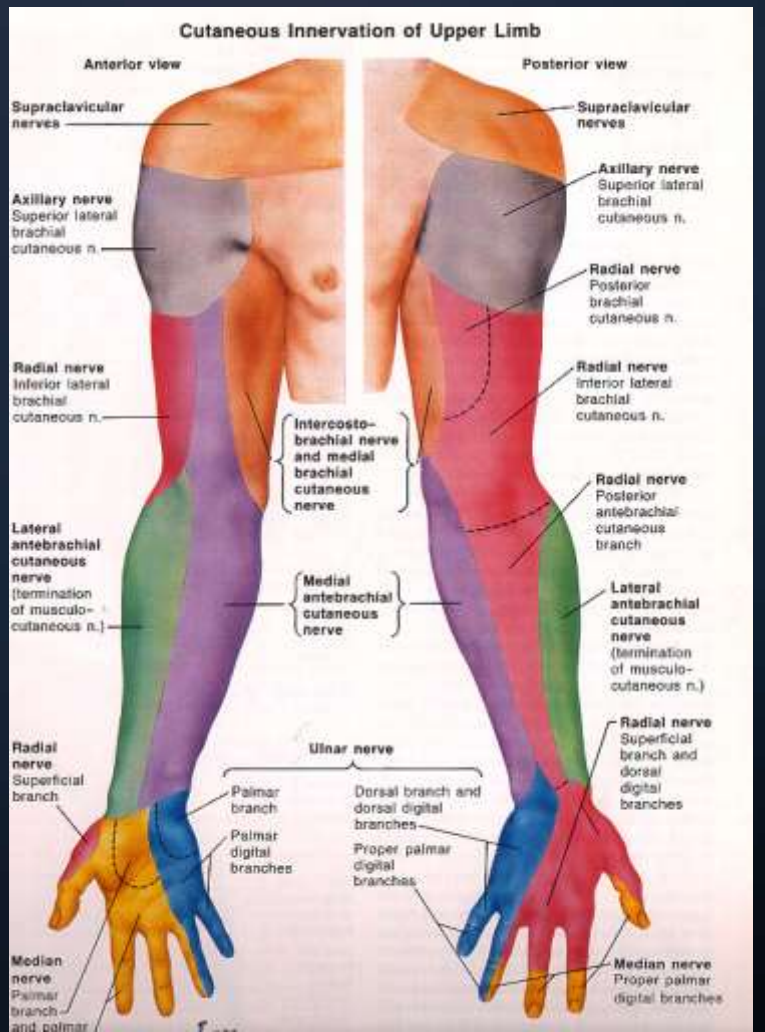
- Osteophytes
  - Uncovertebral or Facet joints
- Disc herniation
  - Central or Lateral extrusion
- Combination



Clinical Presentation

History

- Radiating arm pain
- Sensibility loss
- Motor deficits
- Reflex changes



Clinical Presentation

History

- **Disc herniation after**
  - Trauma
  - Repetitive activity
  - Awaken at night
- **Pain**
  - Severe
  - Burning
  - Tooth-ache quality
- **Dysphagia**

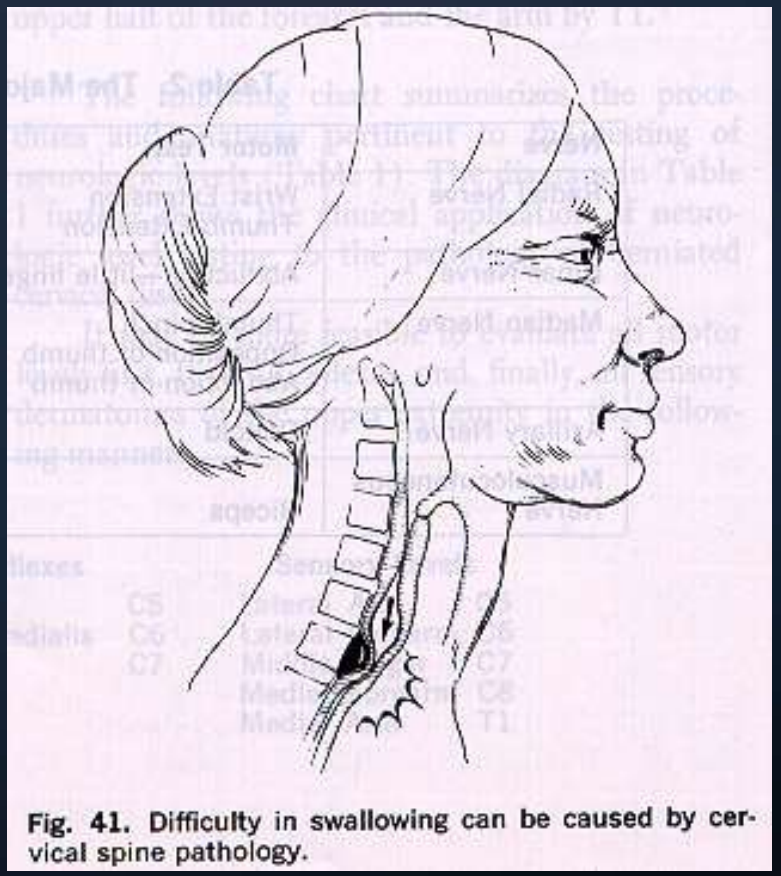


Fig. 41. Difficulty in swallowing can be caused by cervical spine pathology.

Clinical Presentation

History

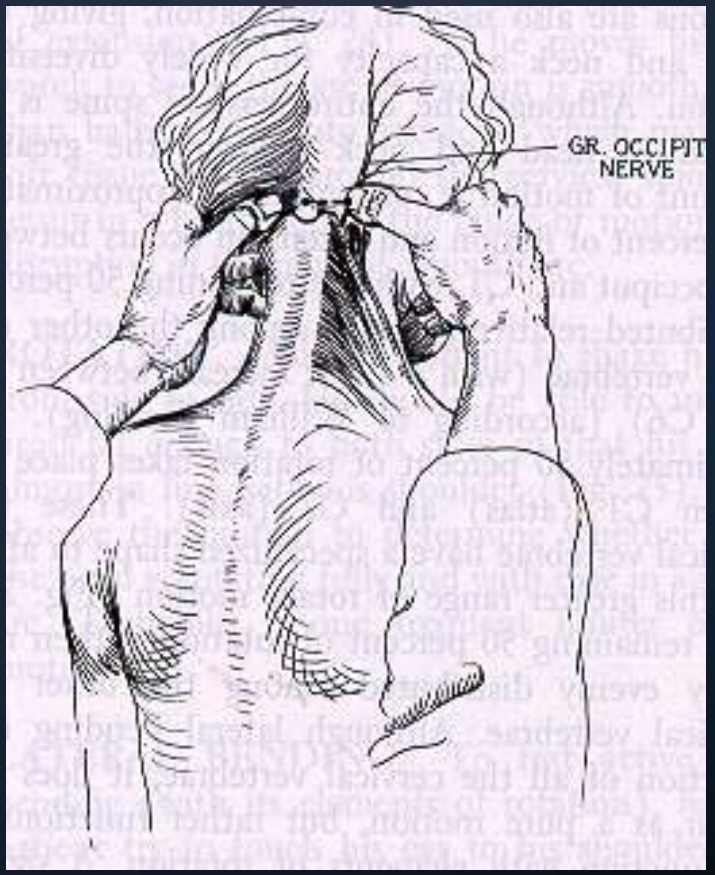
- **Dermatomal distribution**
- **Example: C5-C6 Disc**
  - b/t vertebral body C5 + C6
  - C6 nerve root compression
- **Presenting symptoms**
  - Level of nerve compression

HISTORY

- 65 year old male , failed B. CTR and B. RCT Surgery.
- 54 year old male, WC, failed posterior foraminotomy.

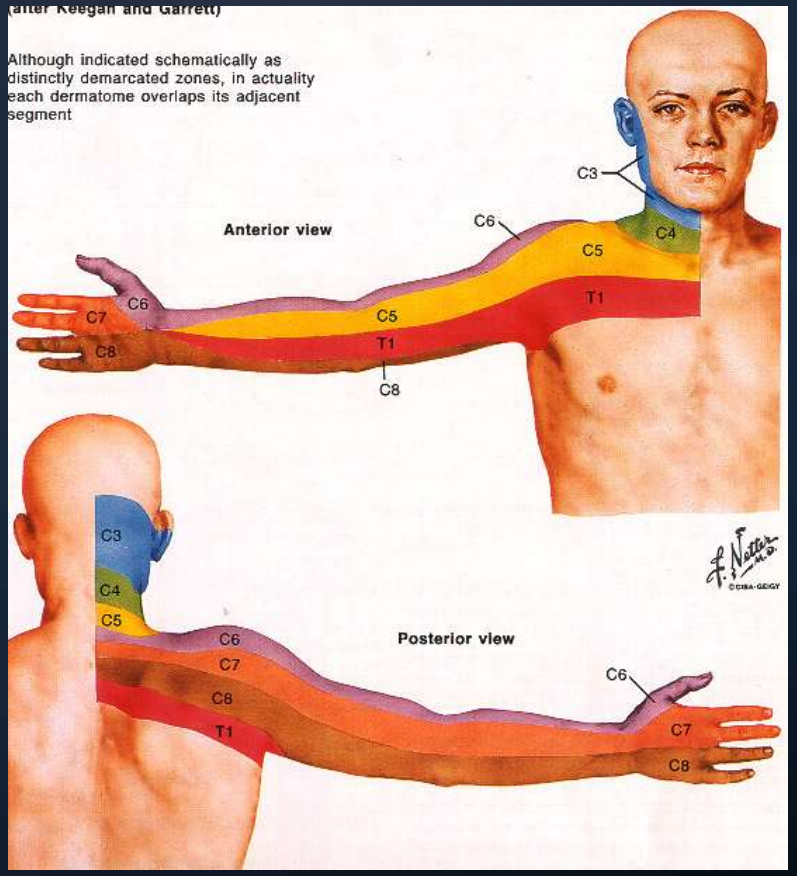
Physical Exam

- Sensation
- Motor strength
- Range of motion
- Deep tendon reflexes



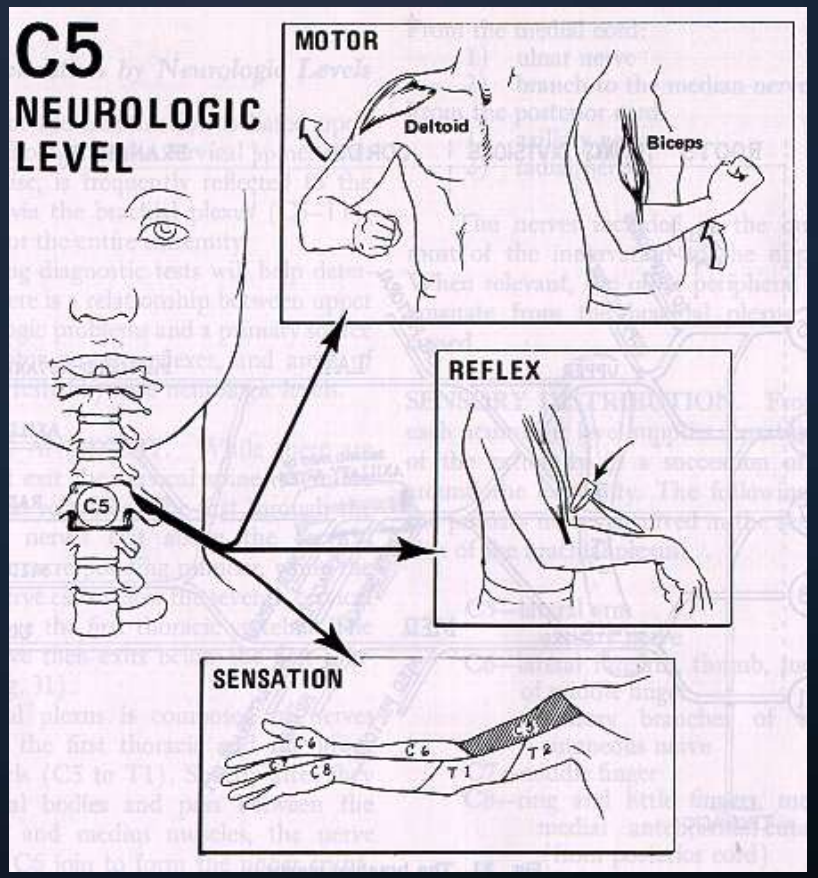
Physical Exam
C4 Radiculopathy

- C3-4 level
- Uncommon
- Weak deltoid
- Variable sensory loss
- Often severe radiating pain
  - shoulder & scapula
- Rule out rotator cuff dz



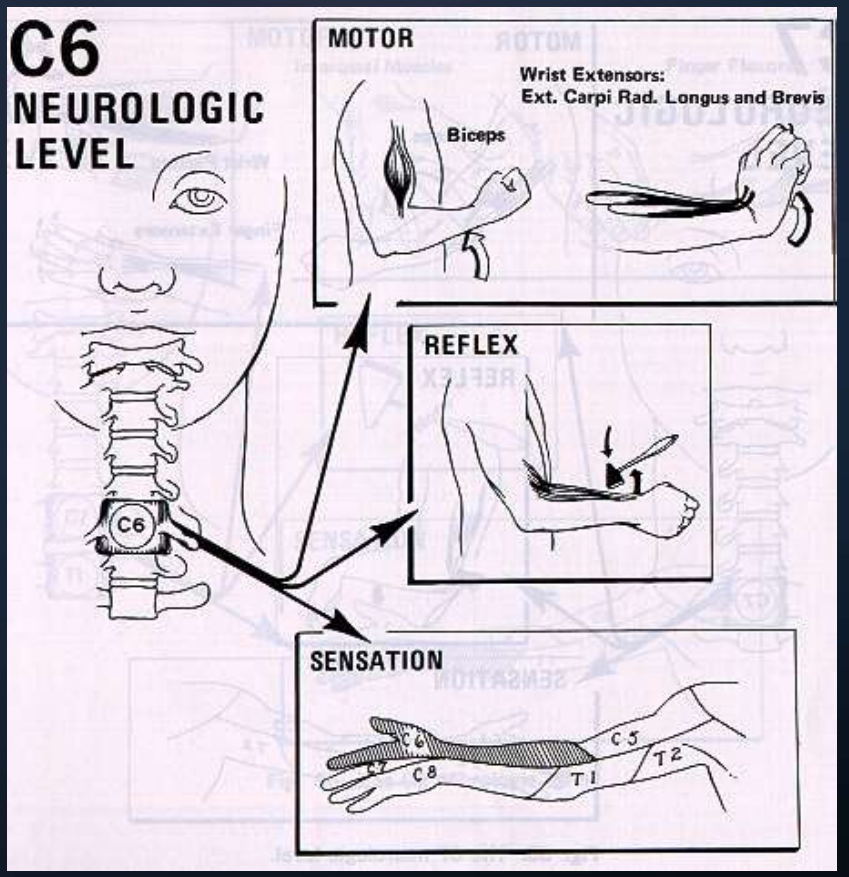
Physical Exam
C5 Radiculopathy

- **C4-5 level**
  - 3rd most common
- **Weak deltoid, shoulder external rotators**
  - perhaps biceps
- **Biceps reflex**
- **Pain & Sensory loss**
  - lateral shoulder
  - lateral brachium



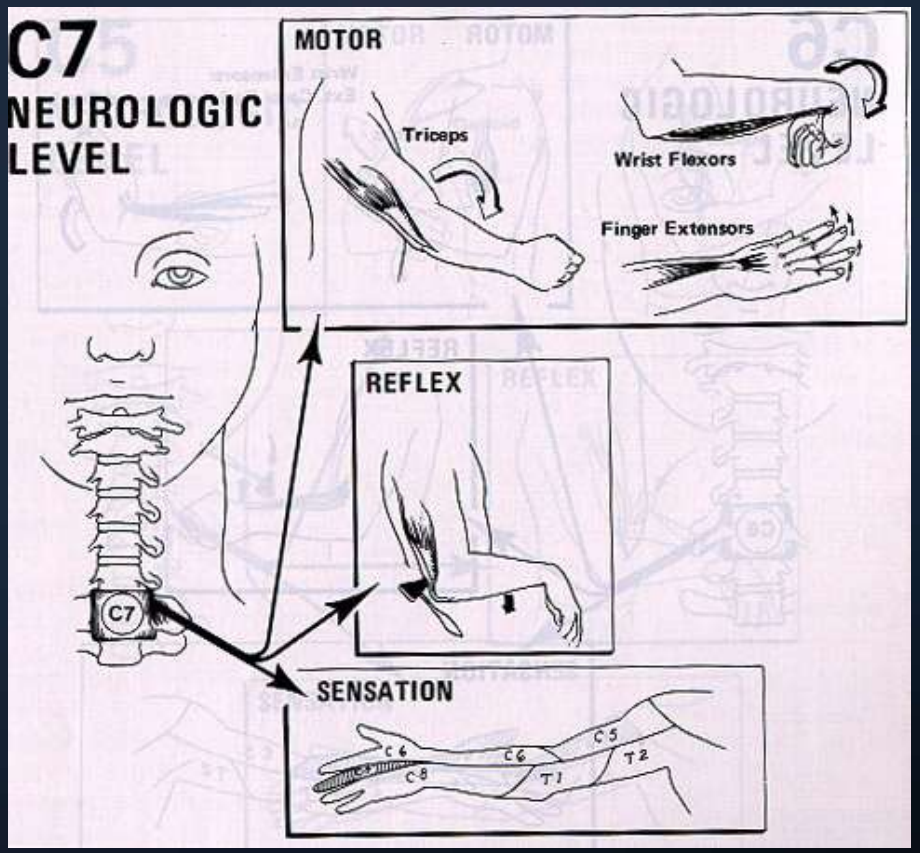
Physical Exam
C6 Radiculopathy

- C5-6 level
- Weak biceps & wrist extension
- Brachioradialis reflex
- Pain & sensory loss
  - radial hand
  - lateral brachium



Physical Exam
C7 Radiculopathy

- C6-7 level
- Weak triceps, wrist flexion, finger ext
- Triceps reflex
- Pain & sensory loss
  - middle finger
  - posterolateral arm



Physical Exam
C8 Radiculopathy

- **C7-T1 level**
  - Infrequent
- **Weak grip**
- **Pain & sensory loss**
  - ulnar hand
  - forearm

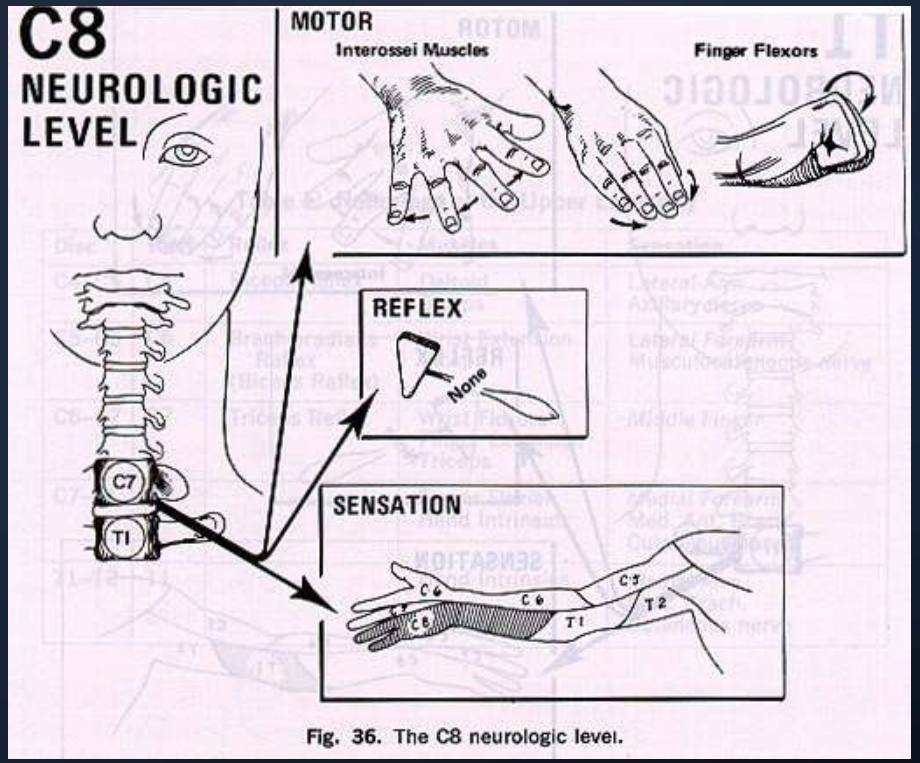
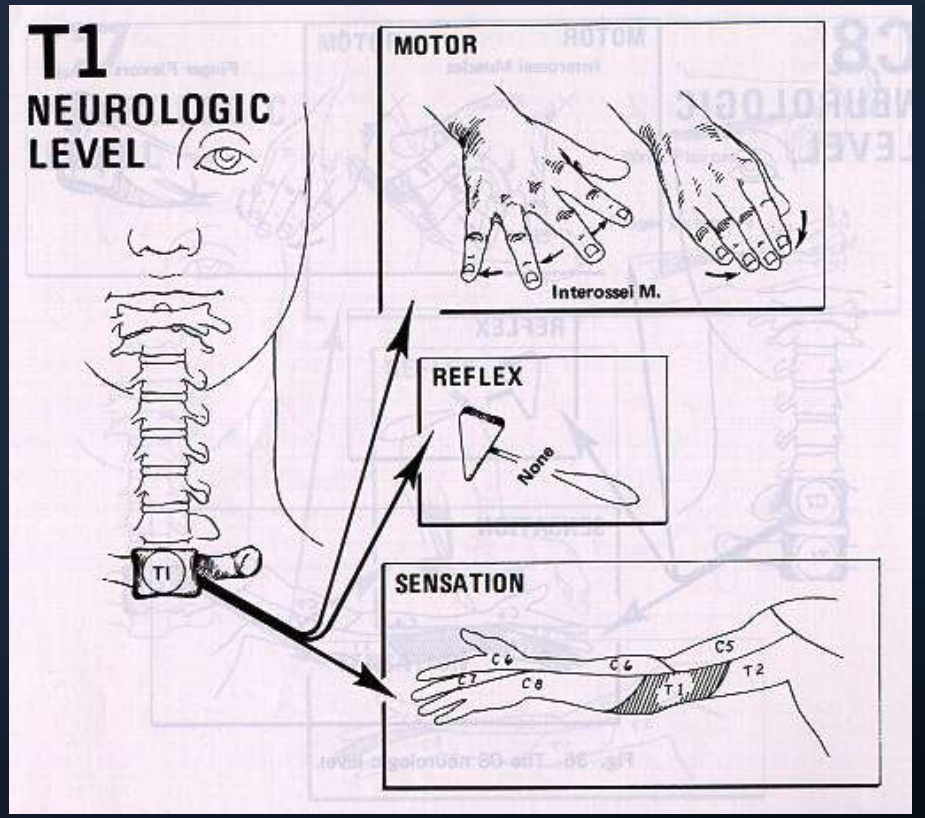


Fig. 36. The C8 neurologic level.

Physical Exam
T1 Radiculopathy

- **T1-2 level**
  - Very uncommon
- **Weak hand intrinsics**
- **Pain & sensory loss**
  - ulnar forearm
  - elbow



Physical Exam

Provocative Tests

- Spurling Test
- Manual Cervical Distraction
- Valsalva Maneuver
- Shoulder Abduction Sign
- L’hermitte’s Sign

Physical Exam
Spurling Test

- **Extending the neck**
- **Rotating head**
- **Downward pressure on head**
- **Positive if pain radiates to side patient's head is pointed**
  - Positive Spurling in 71% football players c recent burner
    (Levitz et al *AM J Sp Med* 1997)

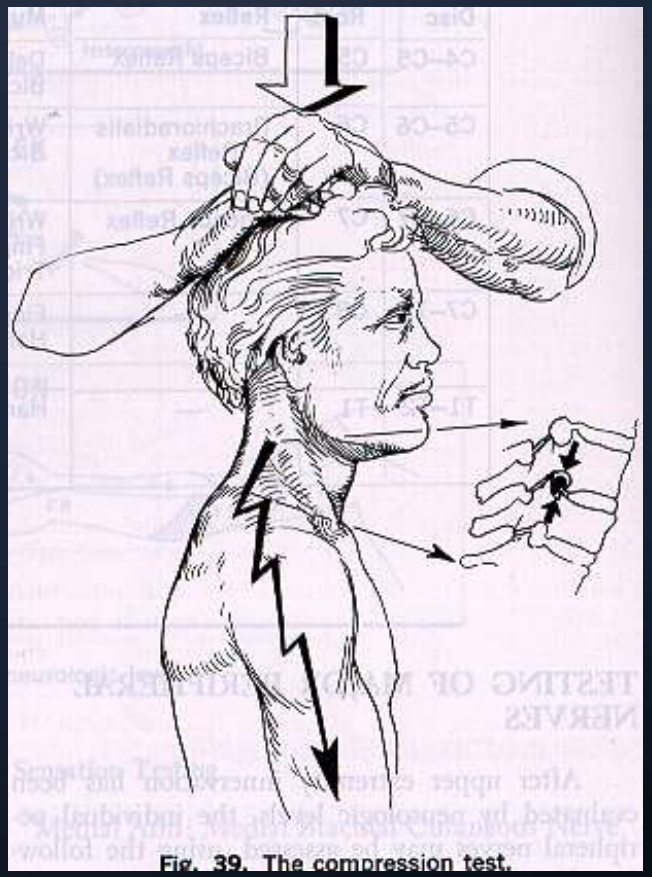


Fig. 39. The compression test.

Physical Exam

Manual Cervical Distraction

- **Supine patient**
- **Gentle manual axial distraction**
  - Up to ~30lbs
- **Positive response reduction neck and limb symptoms**

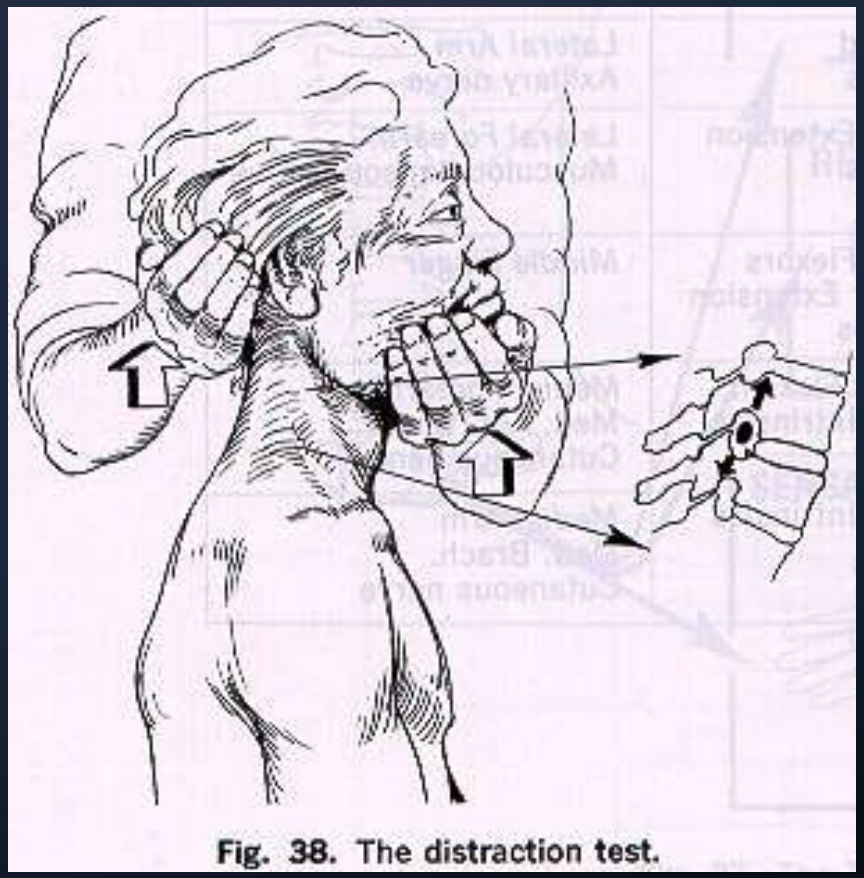


Fig. 38. The distraction test.

Physical Exam

Valsalva Test

- Patient bears down
- Increased intrathecal pressure
- Symptoms reproduced

Fig. 40. The Valsalva test.

Physical Exam

Shoulder Abduction Sign

- While sitting, patient places hand of affected extremity on head
- Support of extremity in scapular plane
- Positive test is reduction of symptoms

Physical Exam
L'hermitte's Sign

- **Neck flexion**
- **Electric-like sensation radiating down spine and/or extremities**
  - Cervical spondylosis
  - Multiple sclerosis
  - Tumor

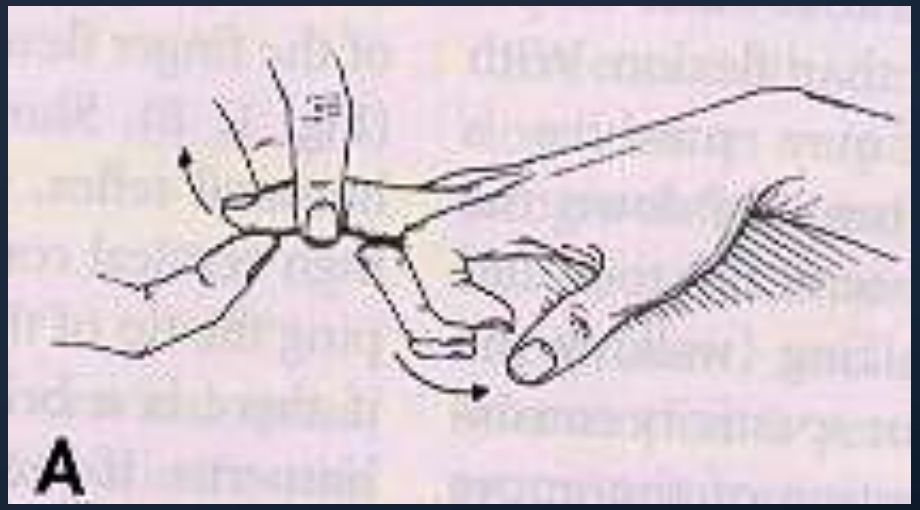
Clinical Presentation

Myelopathy

- **Gait changes**
- **Bowel(18%) or bladder(15%)dysfunction**
- **Simultaneous LE changes**
  - sensory or motor
- **Diffuse hyperreflexia**
  - Upper motor neuron changes
- **20% no neck or arm pain**

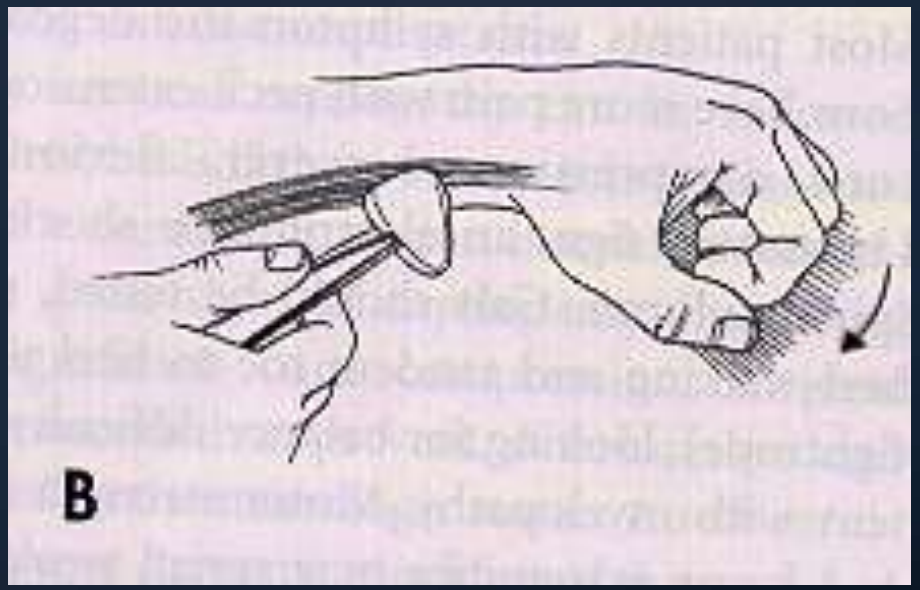
Hoffman's Reflex
Myelopathy

- Suddenly extend middle finger DIP
- Reflex finger flexion
- When asymmetric indicative spinal cord impingement



Inverted Radial Reflex
Myelopathy

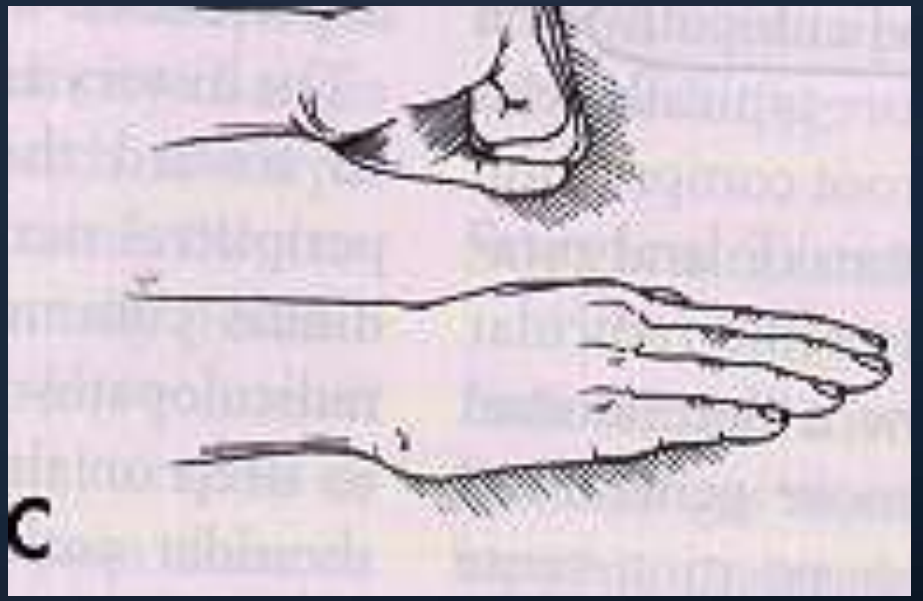
- Tapping of distal brachioradialis tendon
- Spastic contraction of finger flexors



Grip & Release Test

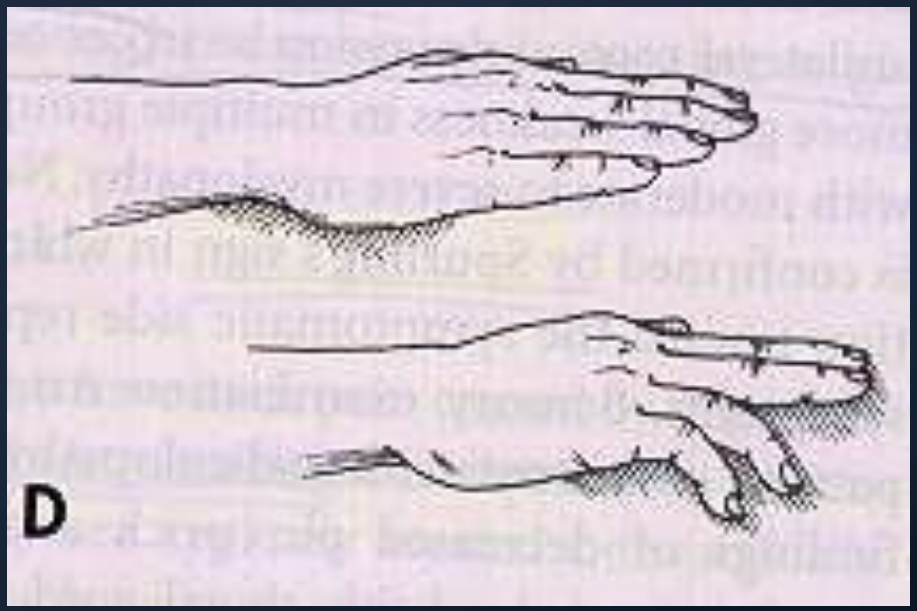
Myelopathy

- Form fist and extend fingers rapidly
- Repeat 20x in 10 seconds



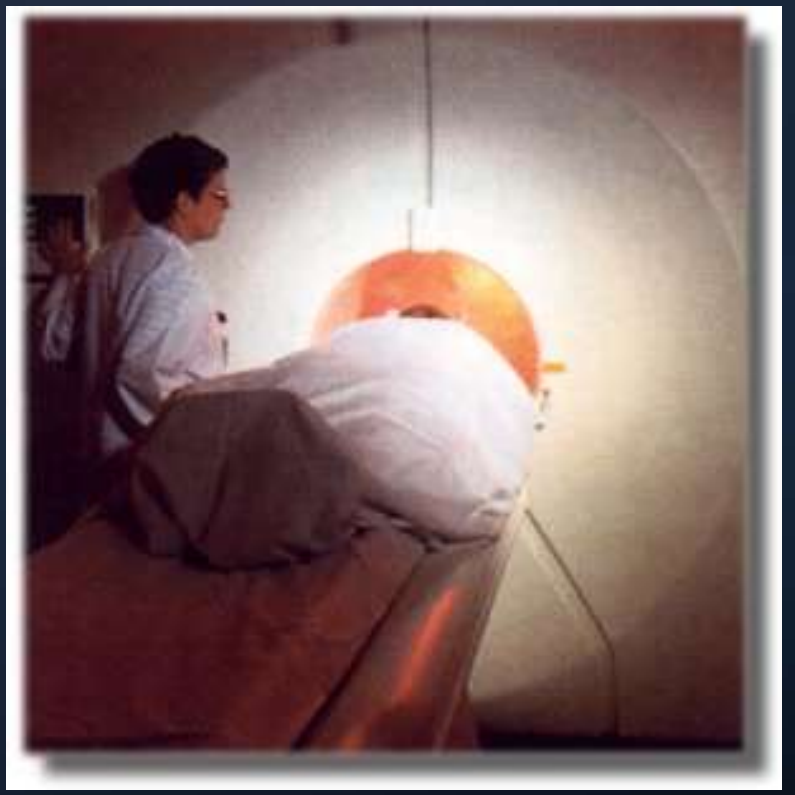
Finger Escape Sign
Myelopathy

- **Hold fingers adducted and extended**
- **Small & ring fingers fall into flexion abduction**
  - Usually within 30 seconds



Radiology

- Radiographs
- Myelogram
- CT Scan
- CT Myelogram
- MRI
- Electrodiagnostics



Radiographs

Cervical Radiculopathy

- **Only initial screening tool**
  - Rule out other insidious diseases
- **Osteophytes**
  - Oblique views
    - Uncovertebral hypertrophy
- **Subluxation**
  - Lateral flexion extension

Radiographs

Cervical Radiculopathy

- 30% asymptomatic individuals over 30 yo will have degenerative changes
- 70% by 70 yo will have degenerative changes on x-ray

Myelogram

Cervical Radiculopathy

- **Intrathecal contrast then X-ray**
- **Assess space occupying lesions by changes in contour**
  - Dural sac
  - Nerve roots
  - Spinal cord

Myelogram

Cervical Radiculopathy

- **Infection risk**
- **Difficulty distinguish nature of defect**
  - Cervical disc herniation
  - Osteophyte
- **Often used in conjunction with CT**

CT
Cervical Radiculopathy

- More sensitive than MRI to bony changes
- Limited ability to detect soft tissue lesions
- Ionizing radiation

CT Myelogram

Cervical Radiculopathy

- **Myelography followed by CT scan**
- **Better detect bony and space occupying lesions**
  - Better anatomic information than MRI?
- **Risk radiation & infection**

MRI

Cervical Radiculopathy

- **Noninvasive, often only study needed**
- **More sensitive to changes disc, spinal cord, nerve root & surrounding soft tissues**
  - 25% asymptomatic patients > 40yo findings of HNP or foraminal stenosis

Radiology Data

Cervical Radiculopathy

- **Blinded retrospective**
- **Correctly predicted cervical spine surgical pathology**
  - MRI 88%
  - CT Myelo 81%
  - Myelography alone 58%
  - CT alone 50%

Brown et al *Am J Neuroradiology* 1988

Treatment

Non-Operative

- Rest
- Immobilization
- Medication
- Physical Therapy
- Cervical traction
- Injections

Operative

- Indications
- Anterior Approach
- Posterior Approach
- Results

Non-Operative Treatment

Cervical Radiculopathy

- **First line therapy**
  - Neck pain
  - Cervical radiculopathy
- **Most do well in 6 weeks**
  - 25% persistent or worsening of symptoms

Immobilization

Cervical Radiculopathy

- **Soft cervical collar**
- **Limits range of motion**
- **Minimize nerve root irritation**
- **Relieve paraspinal muscle spasm**
  - Hopefully reduce inflammation

Medications

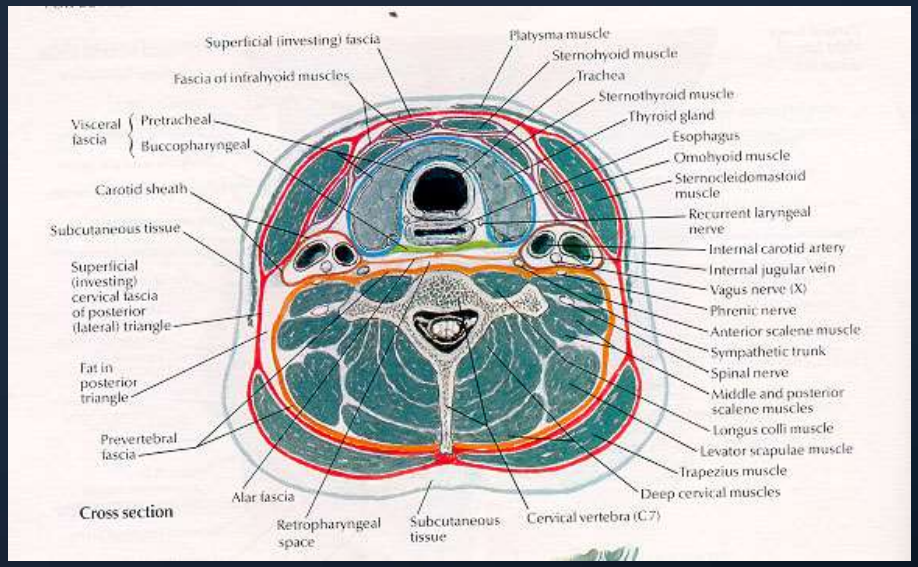
Cervical Radiculopathy

- **NSAIDs**
  - First choice
  - Reduce nerve root inflammation
- **Narcotics**
- **Oral steroids**
- **Local steroids**
- **Epidural steroids**

Injections

Cervical Radiculopathy

- **Epidural steroids**
- **Root injections**
- **Facet blocks**
  - Less often than in lumbar spine
  - Anatomic considerations
  - Experienced staff



Physical Therapy

Cervical Radiculopathy

- Cervical Traction
- Aerobic exercise
- Postural awareness
- Spinal extensor strengthening
- Thermotherapy
- Acupuncture

Cervical Traction

Cervical Radiculopathy

- **Soft disc herniations**
  - Often younger patients
- **Less successful**
  - Spondylosis
  - Narrow spinal canals
- **20-30lb usually effective distractive force**
- **Long-term basis**
  - select patients

Non-Operative Treatment

Cervical Radiculopathy

- **Response in days to weeks**
- **Protracted non-op care not recommended in presence of**
  - Persistent, severe pain
  - Weakness
  - Major sensibility loss
  - Myelopathy with obvious cord findings

Operative Treatment

Indications

- **Compression of nerve root or spinal cord**
- **Instability**
  - Spondylolisthesis
  - Retrolisthesis
- **Deformity**
- **Failed medical management**
- **Significant neurologic deficit**
  - motor weakness
- **Severe cervical myelopathy**

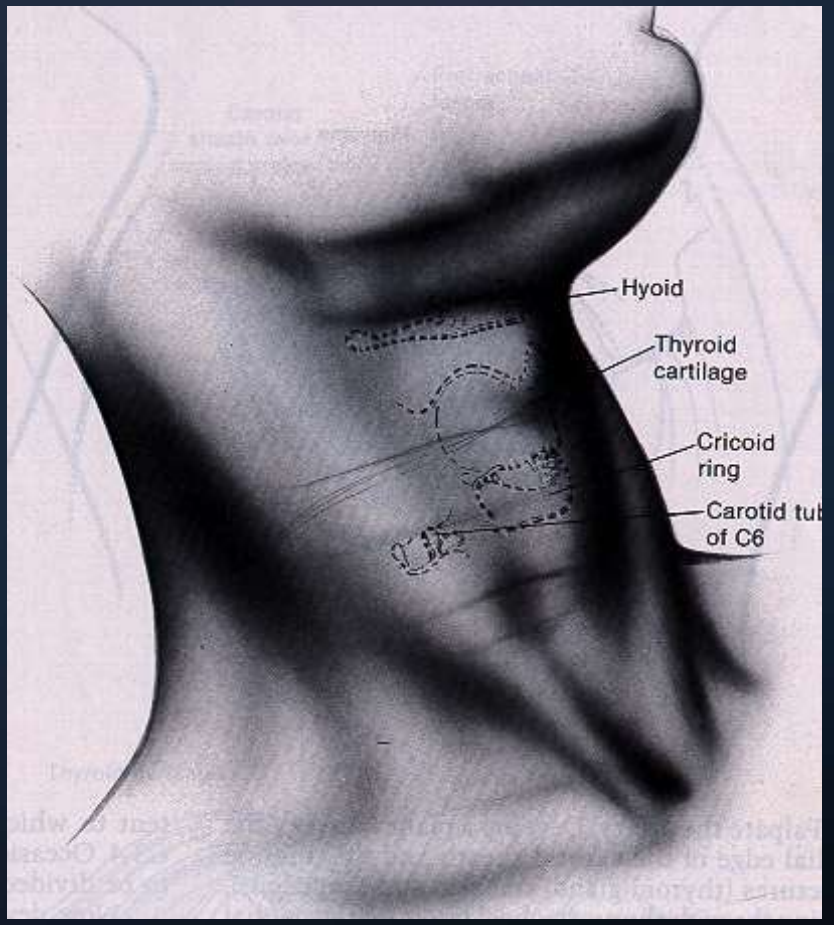
Approach

- **Anterior**
  - ACDF
  - Corpectomy
  - 1 or 2 level dz.
    - (central or lateral)
    - Hard or soft disc
  - Kyphosis
- **Posterior**
  - Foraminotomy
    - Soft lateral disc.
  - Laminectomy
  - Laminectomy + fusion
  - Laminoplasty
  - 3 or more levels with preservation of lordosis.

Anterior Approach

Cervical Radiculopathy

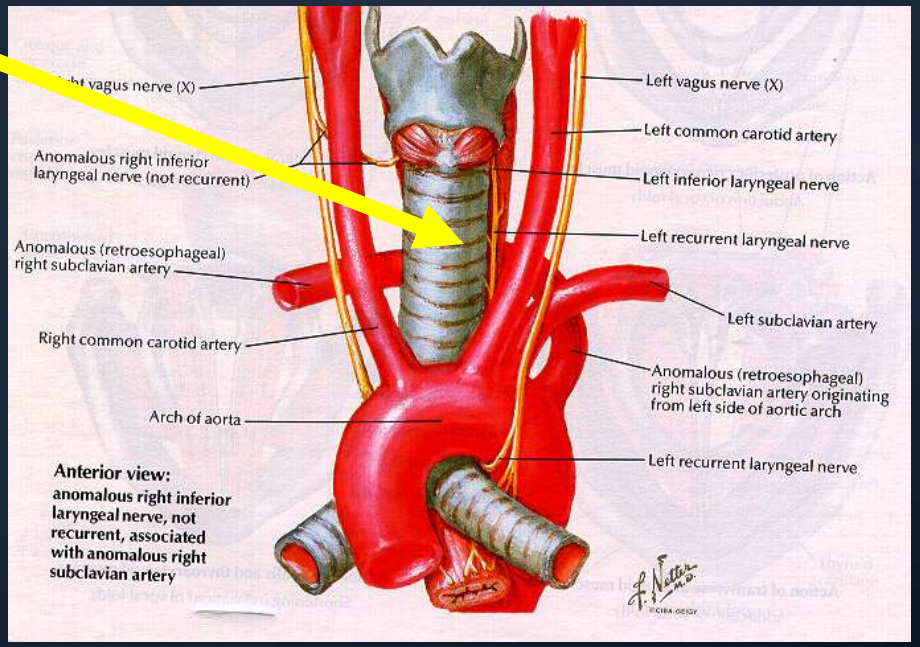
- **Supine on table**
- **Left sided approach**
  - if C4-5 or lower
  - Recurrent laryngeal nerve
- **Can utilize either side if above C4**



Anterior Approach

Cervical Radiculopathy

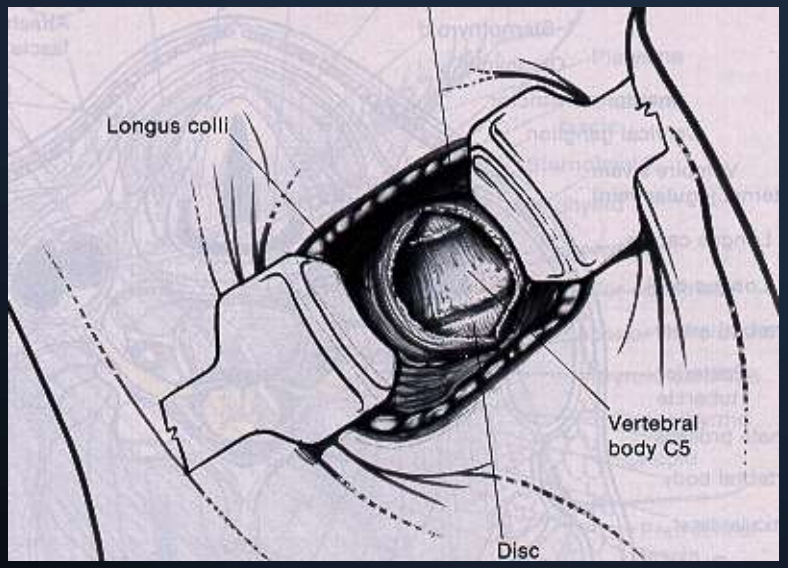
- **Recurrent laryngeal nerve on left**
  - Predictable course
  - Between trachea and esophagus
  - Ascends from looping around aortic arch

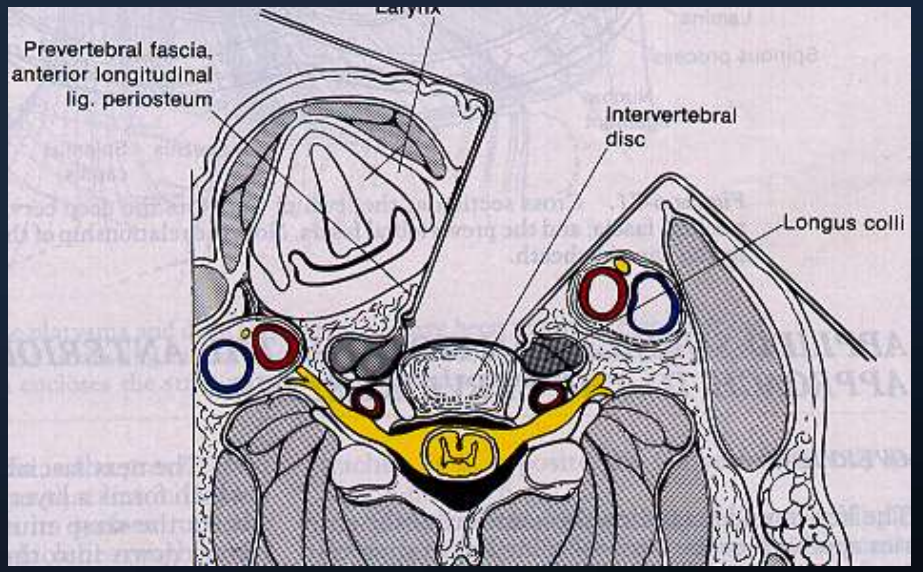


Anterior Approach

Cervical Radiculopathy

- Once at spine level, spinal needle place into disc space
- Lateral radiograph take to confirm location

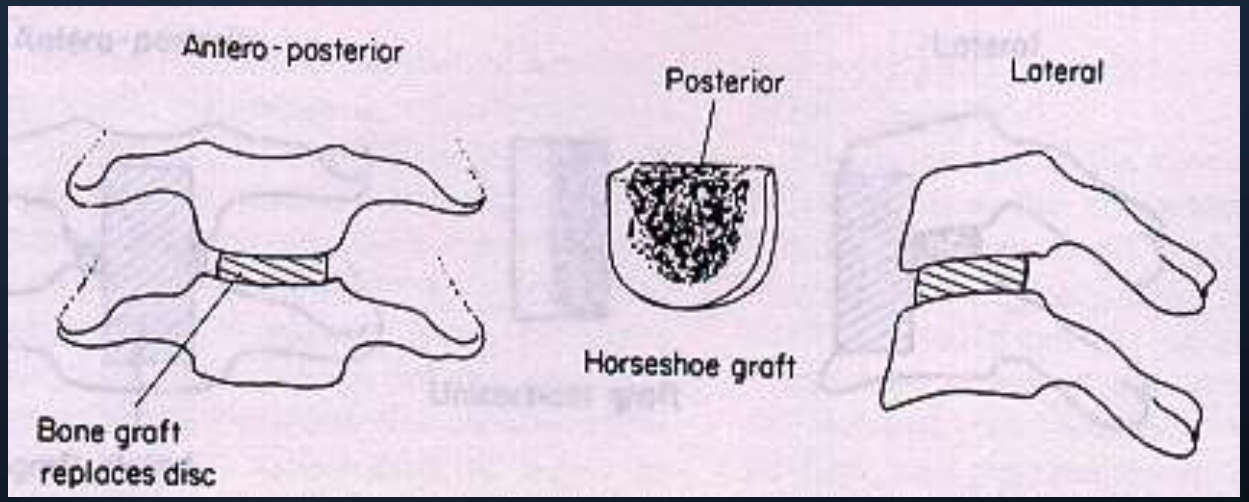




Anterior Approach

Cervical Radiculopathy

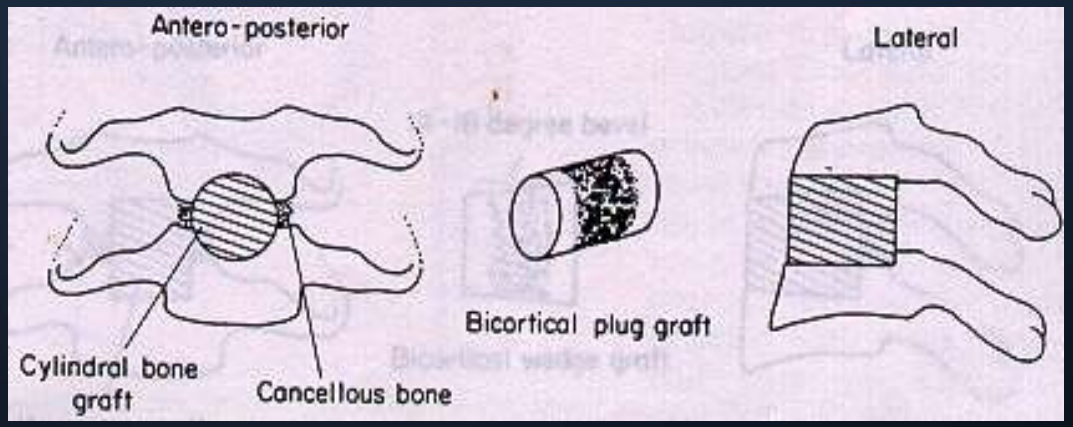
- **Technique described by Robinson & Smith 1955**
  - Use tricortical iliac crest graft



Cloward Technique

Cervical Radiculopathy

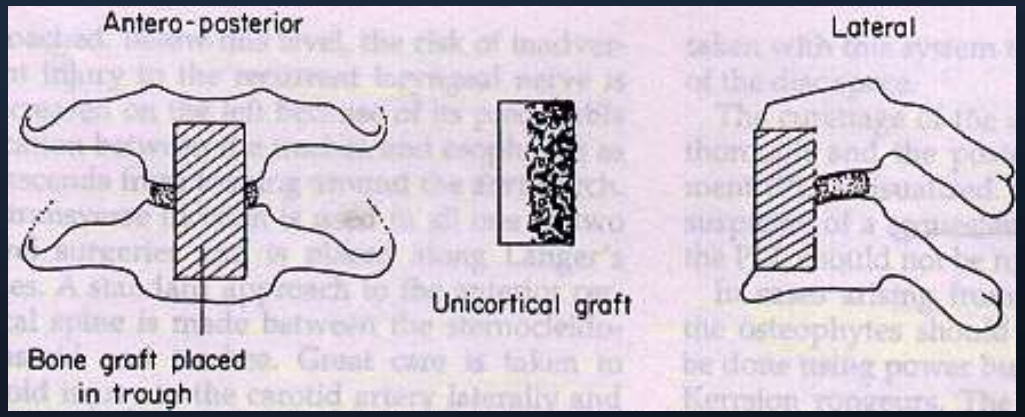
- Dowel type graft
- Variable size, bicortical
- Sized drill hole carefully placed into center involved disc space



Bailey & Badgley

Cervical Radiculopathy

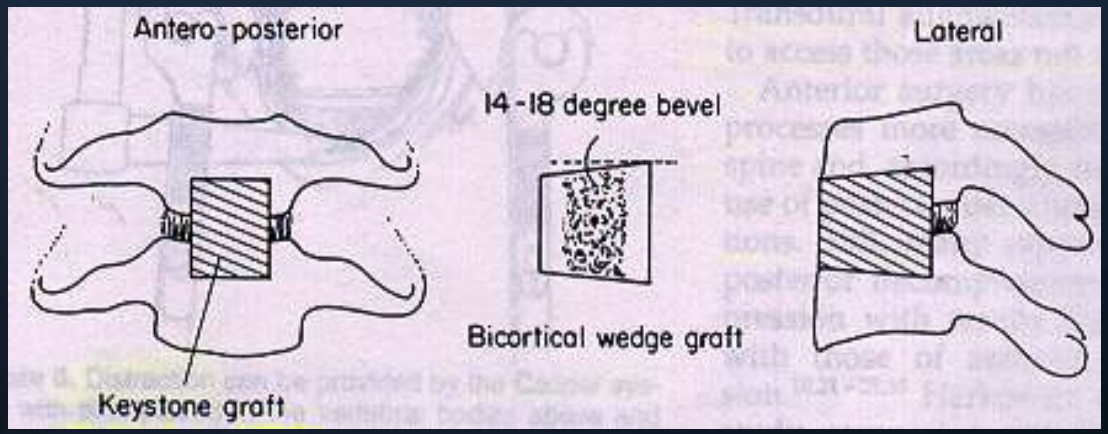
- **Trough made into vertebral bodies**
  - Above and below involved disc
- **Unicortical**
  - ½ inch width
  - 3/16 inch depth



Simmons & Bhalla

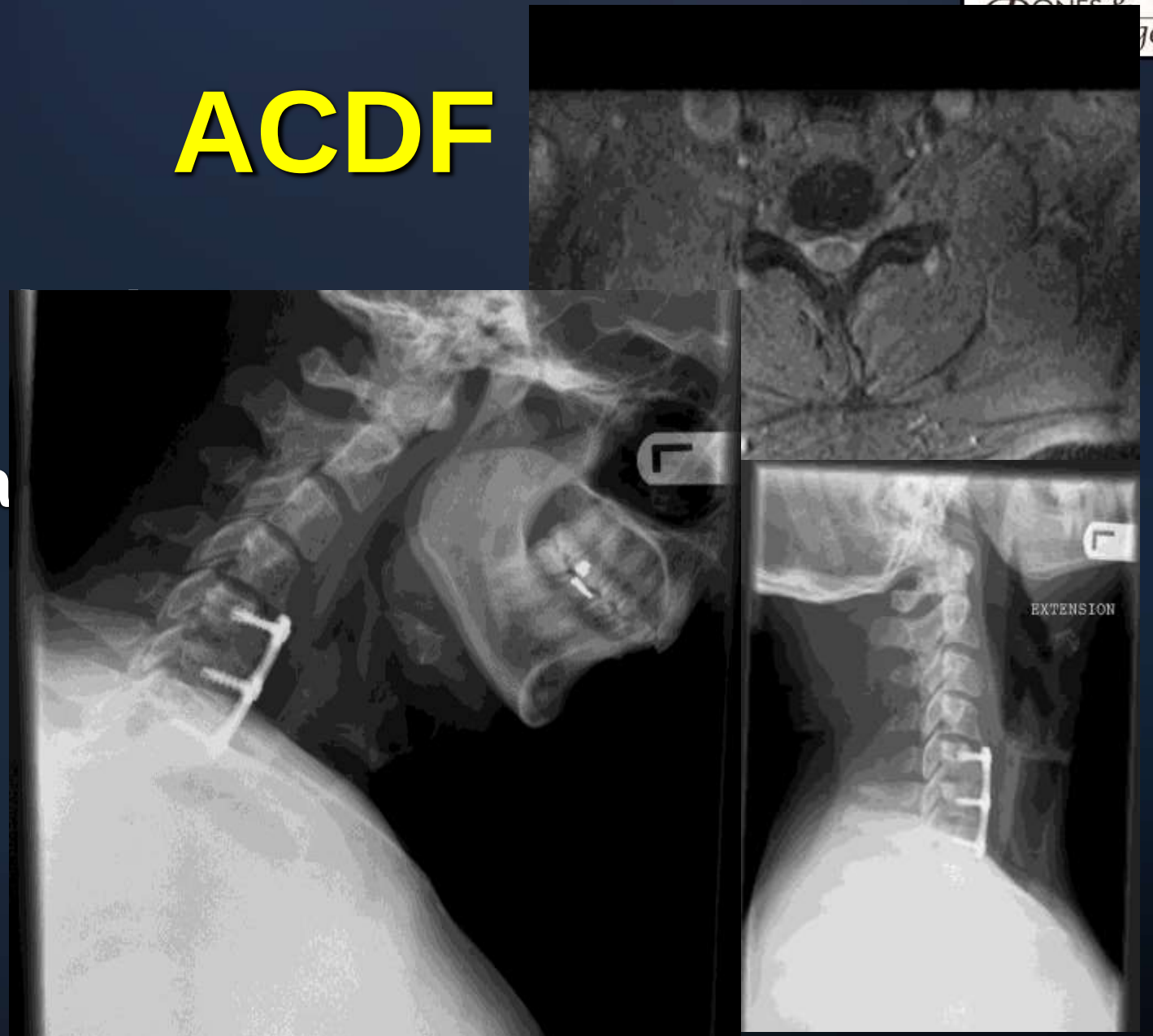
Cervical Radiculopathy

- **Keyhole technique**
- **Beveled bicortical graft**
  - 14-18 degrees ideal
  - Bevel up for superior vertebral body
  - Bevel down for inferior vertebral body



ACDF

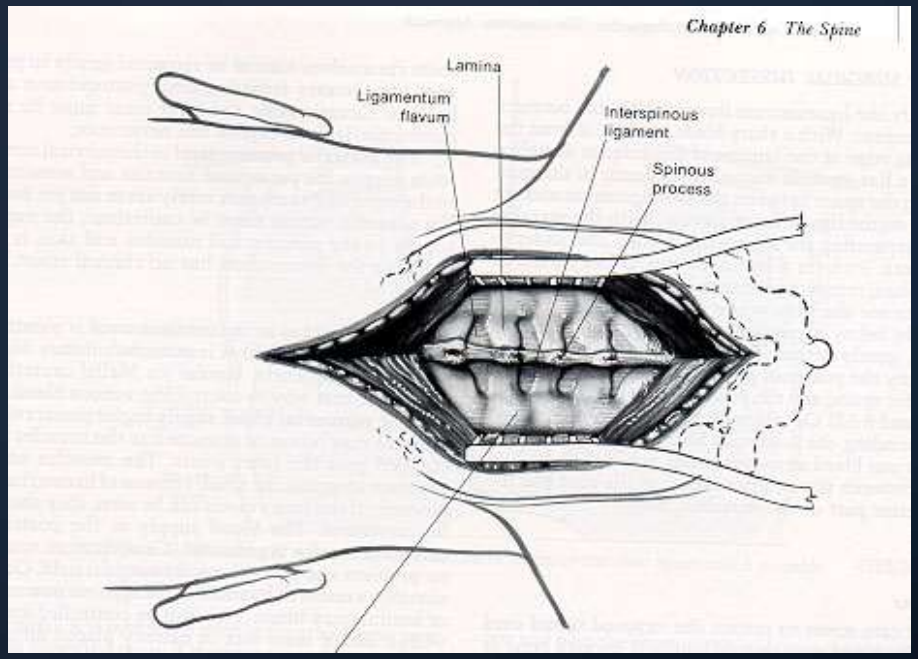
- 42 yo with
and C7
radiculopa



Posterior Approach

Cervical Radiculopathy

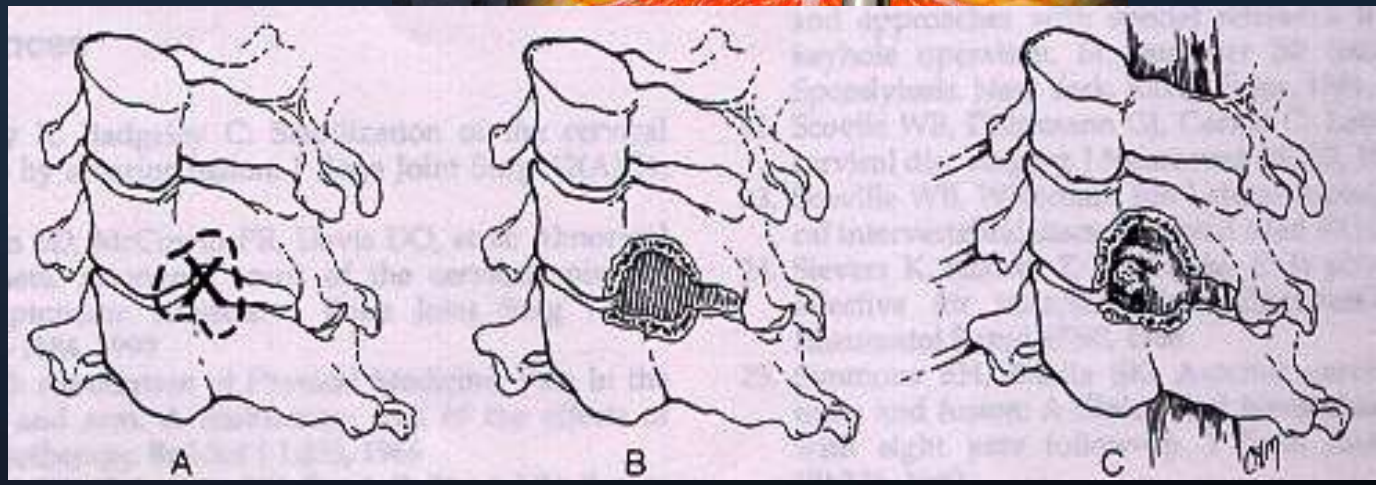
- **Described two decades b/f anterior popularized**
- **Utilized in numerous situations**
  - Lateral soft disc herniation
  - Midline spondylotic myelopathy



Posterior Approach

Cervical Radiculopathy

- **Radiculopathy without neck pain**
- **Keyhole foraminotomy**
  - Lateral discs



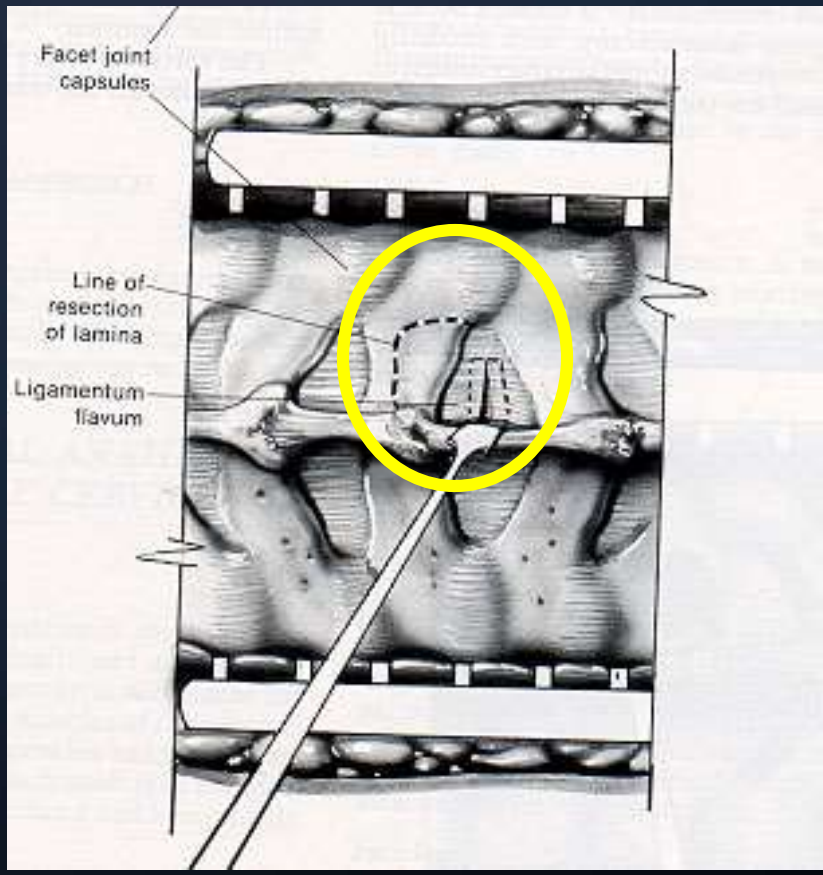
Posterior Approach

Cervical Radiculopathy

Raynor et al *Neurosurg* 1983

- **3-5mm nerve root exposure**
- **1/3 removal facet joint**

- **Similar anterior decompression**
  - work outside direct vision



Posterior Approach

Cervical Radiculopathy

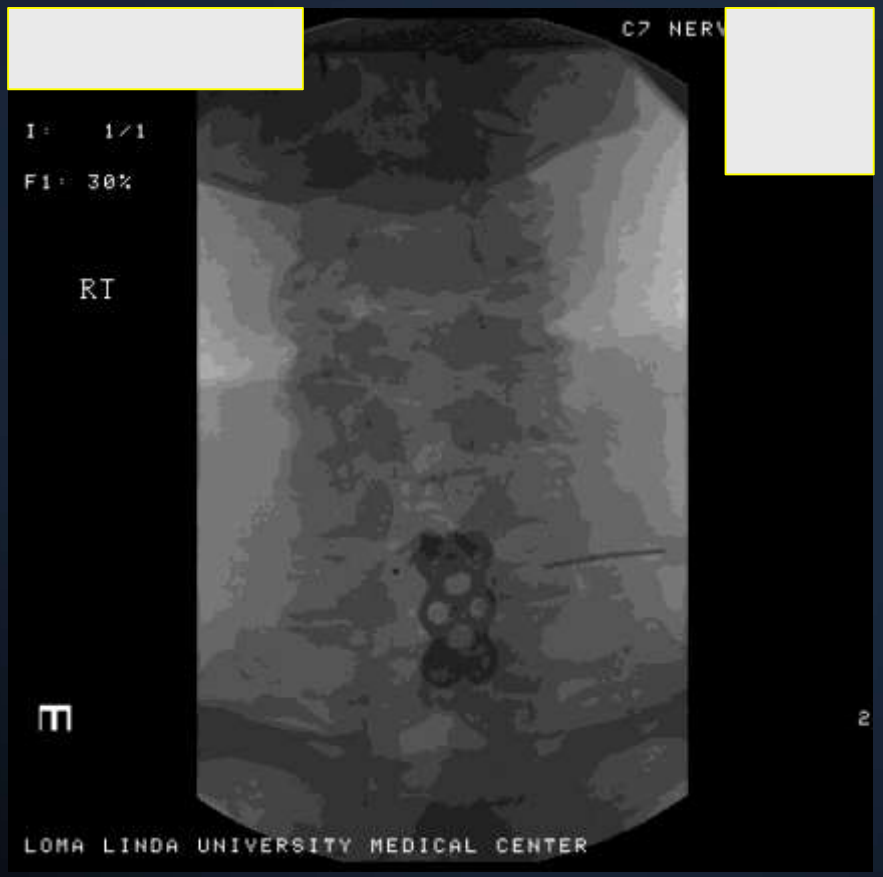
Raynor et al *J Neurosurg* 1985

- **50% B facetectomies**
- **5mm nerve root**
  - exposure
- **Spinal stability intact**

- **70% B facetectomies**
- **8-10mm nerve root**
  - exposure
- **Significant reduction of spine stability to shear**

ANT. CORPECTO
POST FORAMINO

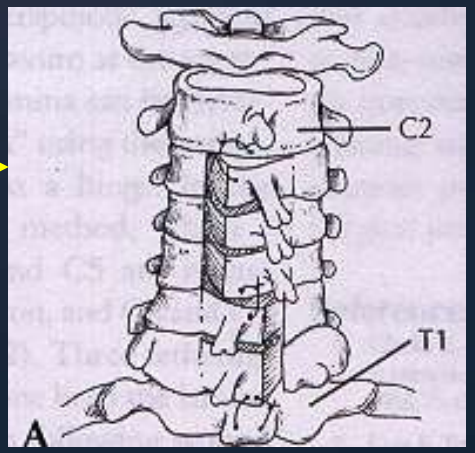
- 59 yo businessman with severe R. arm pa


C7 NERV
I: 1/1
F1: 30%
RT
LOMA LINDA UNIVERSITY MEDICAL CENTER

Posterior Approach

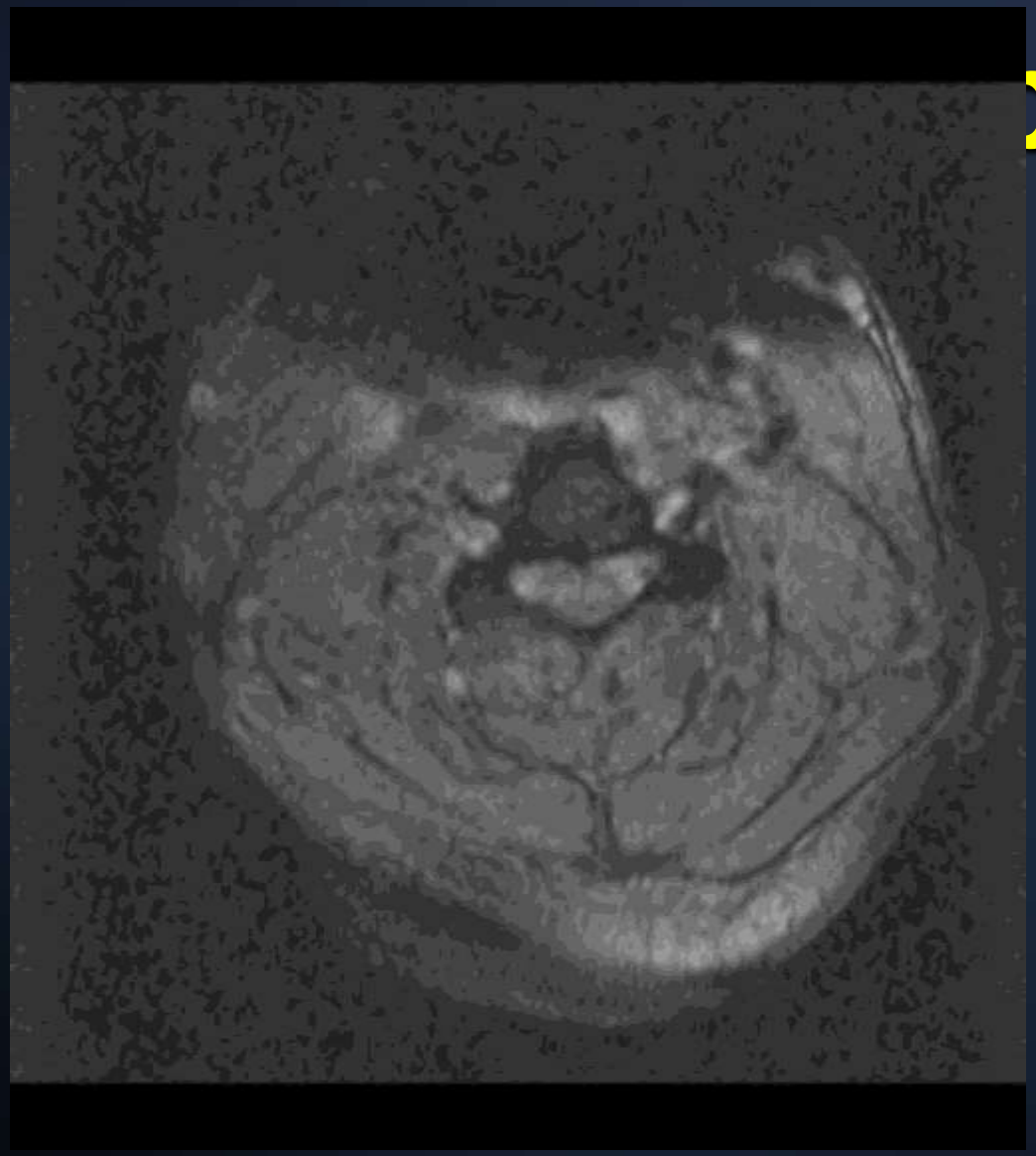
Cervical Myelopathy

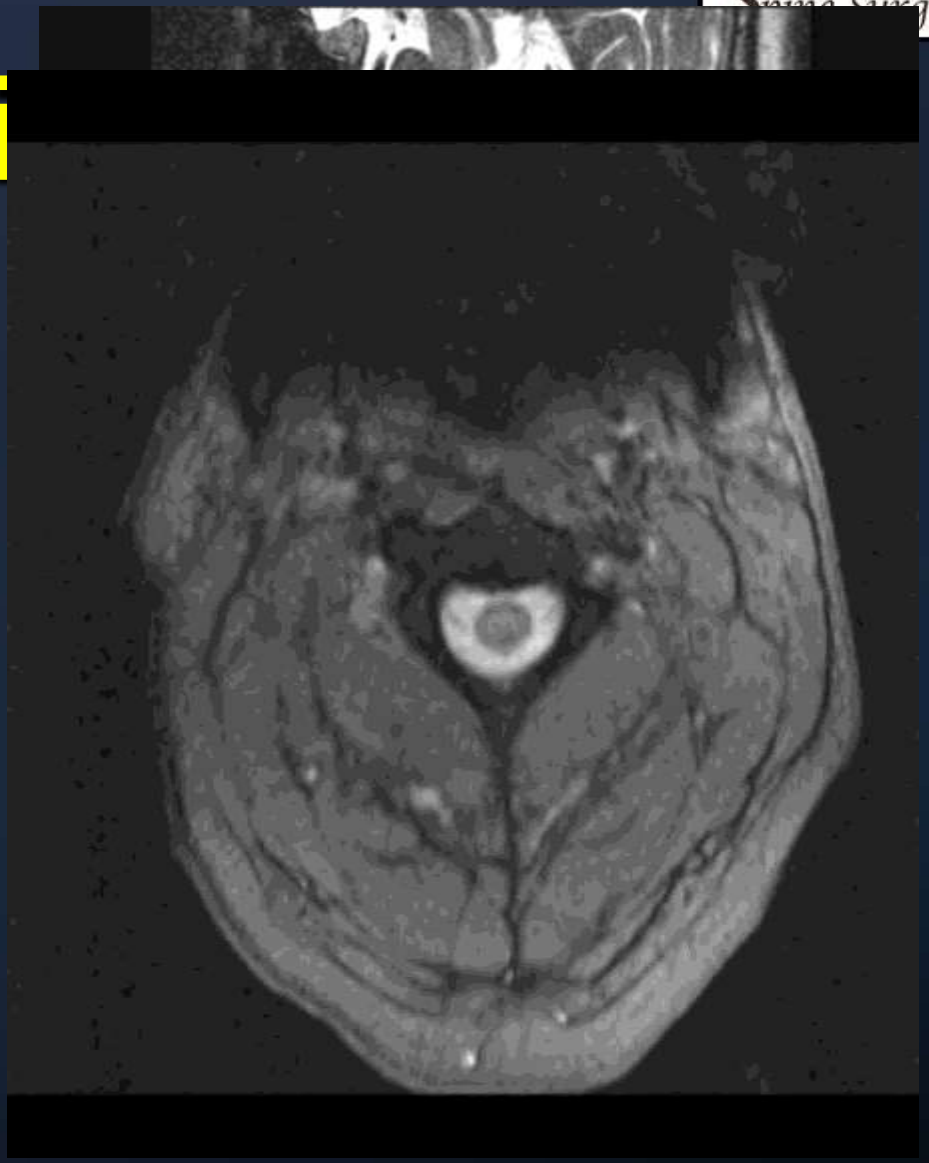
- **Laminoplasty**
  - Stenosis



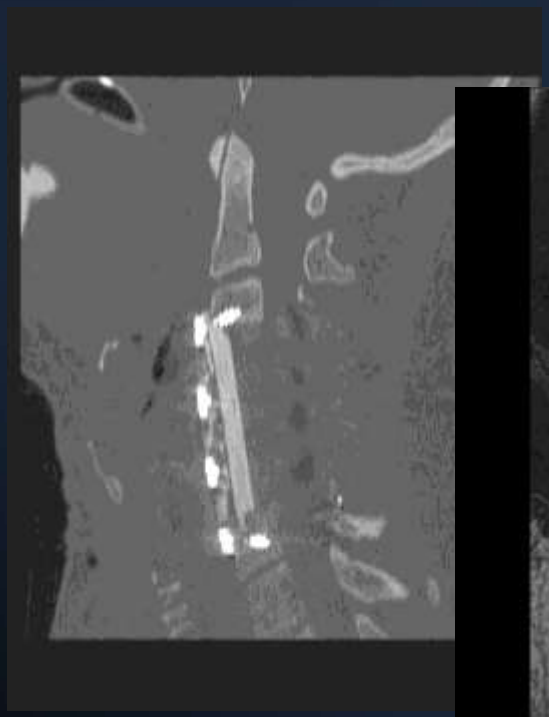
Cerv op

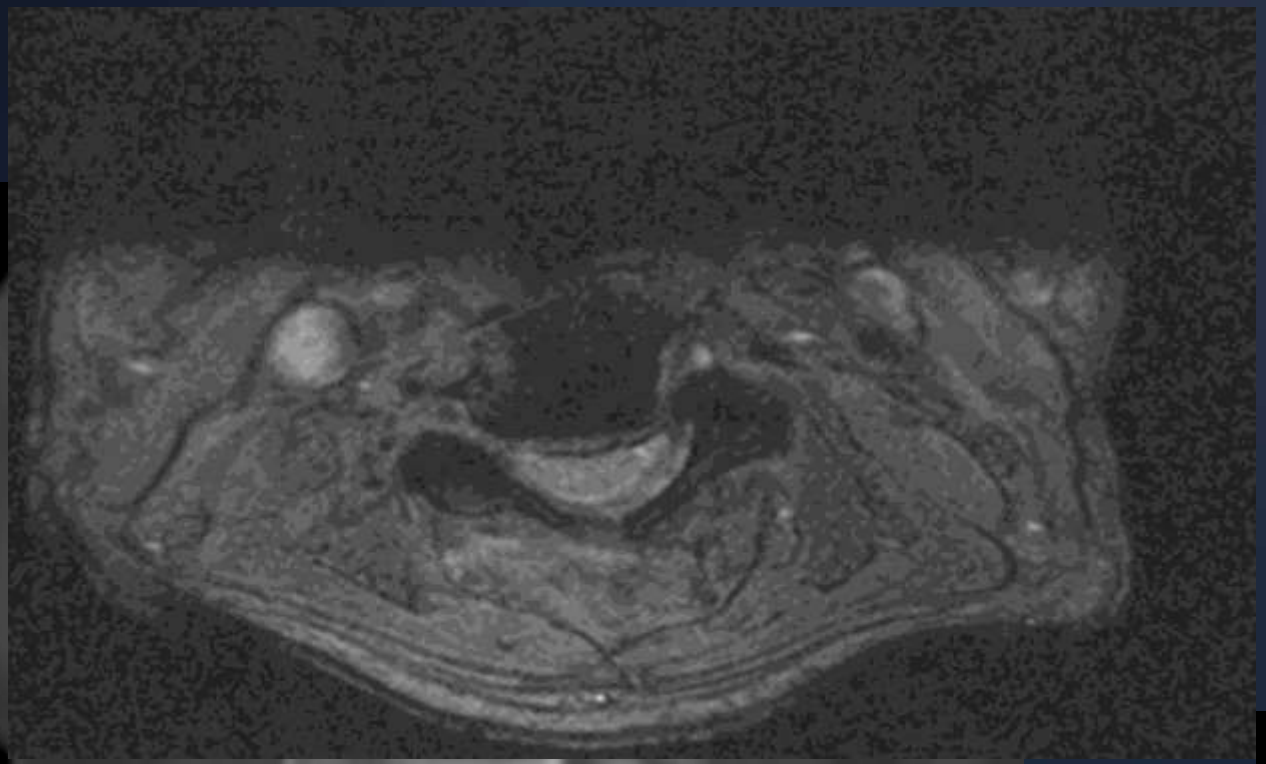
- 81 year
  quadripa
  of functi
  w
  t

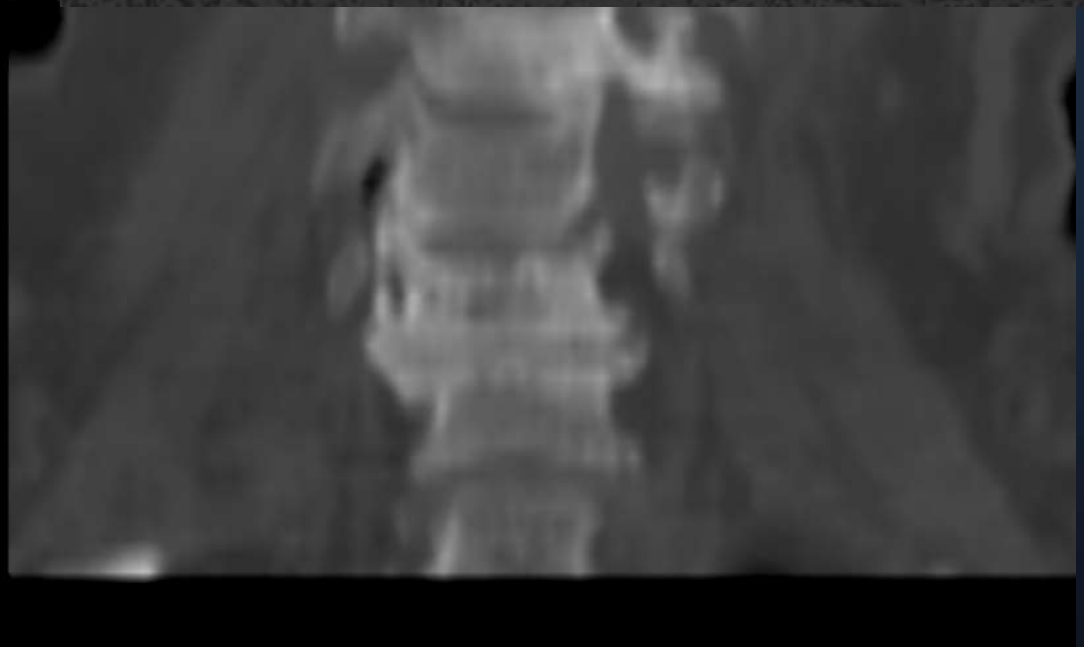




Combined








L
NEUTRAL
UPRIGHT

Combined

OITE

OITE 2000-#73

- **A 45yo man has had spontaneous neck and right arm pain for the past 2 days, and he states that the pain is relieved when he places his hand on the top of his head. Examination reveals decreased sensation on the dorsum of the first web space, weakness in the wrist extensors, and an absent brachioradialis reflex. The remainder of the exam is unremarkable. What is the most likely diagnosis?**

  1—Double-crush phenomenon with carpal tunnel syndrome & cervical disk herniation at C5-6

  2—Cervical disk herniation at C6-7

  3—Cervical disk herniation at C5-6 with myelopathy

  4—Acute cervical disk herniation at C5-6

  5—A shoulder impingement lesion & cervical disk herniation at C6-7

OITE 2000-#73

- **A 45yo man has had spontaneous neck and right arm pain for the past 2 days, and he states that the pain is relieved when he places his hand on the top of his head. Examination reveals decreased sensation on the dorsum of the first web space, weakness in the wrist extensors, and an absent brachioradialis reflex. The remainder of the exam is unremarkable. What is the most likely diagnosis?**

  1—Double-crush phenomenon with carpal tunnel syndrome & cervical disk herniation at C5-6

  2—Cervical disk herniation at C6-7

  3—Cervical disk herniation at C5-6 with myelopathy

  4—Acute cervical disk herniation at C5-6

  5—A shoulder impingement lesion & cervical disk herniation at C6-7

SAE Spine 2000 #2

- **A 60yo man underwent an anterior diskectomy and fusion for C4-5 disk disease using a left-sided approach 1 week ago. He now reports a persistent dry cough and mild horseness. Pulmonary evaluation shows evidence of a mild aspiration, and ear, nose, and throat visualization shows laxity of the vocal cord on the left side. What is the most likely explanation for these findings?**

  1—Traction on the recurrent laryngeal nerve

  2—Traction on the superior laryngeal nerve

  3—Injury to the pharyngeal nerve branches when ligating the superior thyroid artery

  4—Direct trauma to the larynx from retractor blades

  5—Direct injury to the vocal cords from endotracheal intubation

SAE Spine 2000 #2

- **A 60yo man underwent an anterior diskectomy and fusion for C4-5 disk disease using a left-sided approach 1 week ago. He now reports a persistent dry cough and mild horseness. Pulmonary evaluation shows evidence of a mild aspiration, and ear, nose, and throat visualization shows laxity of the vocal cord on the left side. What is the most likely explanation for these findings?**

  1—Traction on the recurrent laryngeal nerve

  2—Traction on the superior laryngeal nerve

  3—Injury to the pharyngeal nerve branches when ligating the superior thyroid artery

  4—Direct trauma to the larynx from retractor blades

  5—Direct injury to the vocal cords from endotracheal intubation

OITE 1999-#24

- **An otherwise healthy 79yo woman has had deteriorating function in her hands for the past 6 months when she is knitting or buttoning. She also reports neck pain and stiffness and diminished sensation in the left hand. Examination reveals a broad-based gait, weakness in the interossei in the left hand, a positive left Hoffman sign, and bilateral upgoing toes. What is the most likely diagnosis?**

  1—Syringomyelia

  2—Pathologic fracture of C4 with incomplete spinal cord injury

  3—Amytrophic lateral sclerosis

  4—Multiple sclerosis

  5—Cervical spondylotic myelopathy

OITE 1999-#24

- **An otherwise healthy 79yo woman has had deteriorating function in her hands for the past 6 months when she is knitting or buttoning. She also reports neck pain and stiffness and diminished sensation in the left hand. Examination reveals a broad-based gait, weakness in the interossei in the left hand, a positive left Hoffman sign, and bilateral upgoing toes. What is the most likely diagnosis?**

  1—Syringomyelia

  2—Pathologic fracture of C4 with incomplete spinal cord injury

  3—Amytrophic lateral sclerosis

  4—Multiple sclerosis

  5—Cervical spondylotic myelopathy